SYSTEMATIC REVIEW FOR UPDATING THE POLYCHLORINATED BIPHENYLS (PCB) EXPOSURE ESTIMATION TOOL AND THE EXPOSURE LEVELS FOR EVALUATING PCBS IN INDOOR SCHOOL AIR

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Table of Contents

1.0 Introduction

EPA is conducting a peer review of the **PCB Exposure Estimation Tool** which was used to develop **Exposure Levels for Evaluating (ELE) PCBs** in indoor school air. The ELEs are intended to represent health-protective benchmarks that can be used to compare and evaluate measured levels of PCBs in indoor school air. The PCB Exposure Estimation Tool was recently updated using a systematic approach to the review of the scientific literature.

The purpose of this document is to provide background information on the PCB Exposure Estimation Tool and ELEs, and the process used to update them. ***This document is not the focus of the peer review. Instead, it is intended to serve as a resource to the peer reviewers to help facilitate their review of the updated Tool and ELEs.*** The PCB Exposure Estimation Tool, Version 2.0 (Excel spreadsheet) and charge questions are being provided separately.

2.0 Background and Purpose

The PCB Exposure Estimation Tool was developed in 2009 (Version 1.1) to help exposure/risk assessors estimate total PCB exposures. It was updated in 2010 (Version 1.2) to include revised dietary dose levels provided by the U.S. Food and Drug Administration (FDA). The Tool provides exposure estimates for school children (daycare, pre-school, elementary, middle and high school) and school staff including teachers and other school personnel. Total PCB exposures are estimated as the sum of exposures occurring in non-school (background) and school settings. Non-school exposure pathways include indoor and outdoor air, indoor dust, outside soils and total diet. School exposure pathways include school indoor and outdoor air, indoor dust, and nearby outside soils. The Tool has also been used to calculate the maximum PCB concentration in indoor school to which individuals could be exposed without exceeding the reference dose (RfD) for PCB Aroclor 1254 (the more conservative of the two RfDs available for PCB Aroclors; https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?&substance_nmbr=389) when all other school and non-school PCB exposure pathways are set to average background levels. These school indoor air PCB concentrations, rounded to one significant figure, have been used as ELEs for PCBs in indoor school air. According to EPA's website (https://www.epa.gov/pcbs/exposure-levels-evaluating-polychlorinated-biphenyls-pcbs-indoor-school-air), "The ELEs were derived to serve as health protective values intended for evaluation purposes. They should not be interpreted nor applied as "bright line" or "not-to-exceed" criteria, but may be used to guide thoughtful evaluation of indoor air quality in schools."

Note that the input values in the Tool can be changed, as needed, to estimate exposures or calculate ELEs for specific sites or populations. The Tool will automatically calculate PCB exposures and maximum indoor air PCB concentrations without exceeding the RfD, based on the user-defined inputs.

The current ELEs, as posted on EPA's website above are summarized in Table 1.

Table 1. Exposure Levels for Evaluating PCBs in School Indoor Air (ng/m^3) [a]

1-<2 years	2-<3 years	3-<6 years	6-<12 years	12-<15 years	15-<19 years	19+ years
100	100	200	300	500	600	500

[a] https://www.epa.gov/pcbs/exposure-levels-evaluating-polychlorinated-biphenyls-pcbs-indoor-school-air

EPA recently conducted a systematic review of the scientific literature to update the PCB Exposure Estimation Tool and ELEs, as described below.

2.1 Overall Objectives

The overall objective of the systematic review was to identify and evaluate PCB-exposure related studies that have been published since the PCB Exposure Assessment Tool was developed in 2009. A review of the scientific literature was needed to determine whether any new data were available that would impact the input assumptions used in the Tool to calculate the Exposure Levels for Evaluating PCBs (ELEs) in Indoor School Air.

2.2 Specific Aims

To update the Tool, EPA:

- Conducted a systematic review of the literature to identify recent literature that could potentially impact the input data and assumptions in the Tool. Literature pertaining to background exposure concentrations of PCBs, as outlined in the population, exposure, comparator, and outcome (PECO) framework below was of interest.
- Revised the Tool and corresponding ELEs, as needed, to reflect the recent data compiled from the literature.
- Revised the Tool with data from the *Exposure Factors Handbook*: 2011 Edition and its recent updates, as appropriate.

2.3 Population, Exposure, Comparator, and Outcome (PECO) Framework

A PECO framework (see Table 2) was used as an aid to focus the search terms, and inclusion/exclusion criteria in the systematic review.

Table 2. Population, Exposure, Comparator, and Outcome (PECO) Framework

PECO Element	Evidence
Population	The focus of the PCB Exposure Estimation Tool is on school age children and school staff, but data for any sites where populations may be exposed to background levels of PCBs in environmental media would be of interest (e.g., general population).
Exposure	Studies that address the following will be considered informative: dietary exposure to PCBs, and total PCB concentrations in indoor dust, soil, indoor air, and outdoor air. Total PCBs may be defined by the sum of PCB congeners, sum of homologue groups, or Aroclors.
Comparator	Individual studies are not required to have a comparison group for inclusion. Although the primary focus would be on nationally representative US data, site-specific data may be of interest in the absence of nationally representative data. Site-specific data for more than one location may be used for comparison purposes. Also, during the post-screening analysis, data from other countries may be of interest for comparative purposes.
Outcome	Dietary exposure estimates should be expressed in units of mg/kg-day, mg/day or similar units to be useful for updating the Tool. Results of studies that focus on environmental concentrations should be expressed as µg/g (soil and dust) or ng/m^3 or similar units to be useful for updating the Tool.

3.0 Methods

3.1 Identification of Literature

3.1.1 Literature Search Strategies

The literature search was conducted by EPA library staff using EPA's Health and Environmental Research Online (HERO) database.[1] It focused on PCBs in environmental media (soil, dust, indoor air, outdoor air) and dietary exposure. Drinking water was not included because according to ATSDR (2000), "drinking water is not considered a significant pathway for exposure."

3.1.1.1 Timeframe

The HERO literature search was conducted in December 2018 and focused on studies published since the PCB Exposure Estimation Tool was developed in 2009. The search was conducted to identify literature published between January 1, 2008 through the December 2018.

3.1.1.2 Search Terms (Keywords)

The search terms and search strings were developed in collaboration with HERO librarians using the following key terms. The search strings used in the literature search are provided in Appendix A. Iterative refinements of the search string occurred as needed.

Dietary Exposure

- Polychlorinated biphenyls or PCBs, or related terms
- Dietary intake or dietary exposure or total diet or dietary or ingestion or food

Media Concentrations

- Polychlorinated biphenyls or PCBs, or related terms
- Concentration or levels
- Dust or dust ingestion or dust contact or dust dermal
- Soil or soil ingestion
- Air or inhalation or inhalation exposure (indoor, residential or homes or apartments, buildings or schools, outdoor, ambient)

The search was refined to exclude papers that addressed topics such as:

- Emissions or emissions modeling
- Physical-chemical properties
- Sources

[1] EPA's HERO (https://heronet.epa.gov) database provides access to the scientific literature behind EPA science assessments. The database includes more than 600,000 scientific references and data from the peer-reviewed literature used by EPA to develop its regulations.

- Fate
- Wildlife
- Toxicity

3.1.1.3 Databases Searched

The following databases were searched for relevant literature:

- PubMed (National Library of Medicine)
- Web of Science (Thomson Reuters)
- ToxLine (National Library of Medicine)

3.1.1.4 Citation Mapping

Citation mapping was conducted using the references cited in the current tool (Version 1.2). This was done to identify more recent references that cited any of the prior studies and served as a way of focusing the literature search on the types of studies used previously to develop the Tool. The references used in the citation mapping are presented in Appendix B.

3.1.1.5 Targeted Internet Search

In addition, targeted internet searches were conducted in November 2018 and February 2019 to identify literature on PCB concentrations in environmental media and the diet. The search terms included:

- PCBs in dust
- PCBs in soil
- PCBs in air
- PCBs dietary exposure

The results of the search are summarized in Appendix C.

3.1.2 Title and Abstract Screening

- Distiller SR software (https://www.evidencepartners.com/products/distillersr-systematic-review-software/) was used to screen the titles/abstracts identified in the HERO literature search.
- Two reviewers used Distiller SR to screen titles/abstracts. Studies were only excluded if both reviewers agreed that they were not relevant to the PECO statement. Any conflicts between reviewers were resolved by consultation between the reviewers. If conflicts could not be resolved, the study was included for full-text review.
- Screening questions were developed to help categorize the references. For example, screeners responded to questions about how the study was identified (literature search or citation mapping) and whether it met the PECO criteria ('yes,' 'yes but already cited in the tool,' 'no,' or 'unclear'). For studies that met the PECO criteria (i.e., were found to

be potentially relevant and were tagged 'yes' or 'yes but already cited in the tool'), screeners responded to an additional question used to categorize the paper according to the topic that it addressed (i.e., soil, dust, indoor air, outdoor air, or dietary exposure).

Figure 1 provides an example of a screenshot of a Distiller SR page used to screen titles/abstracts.

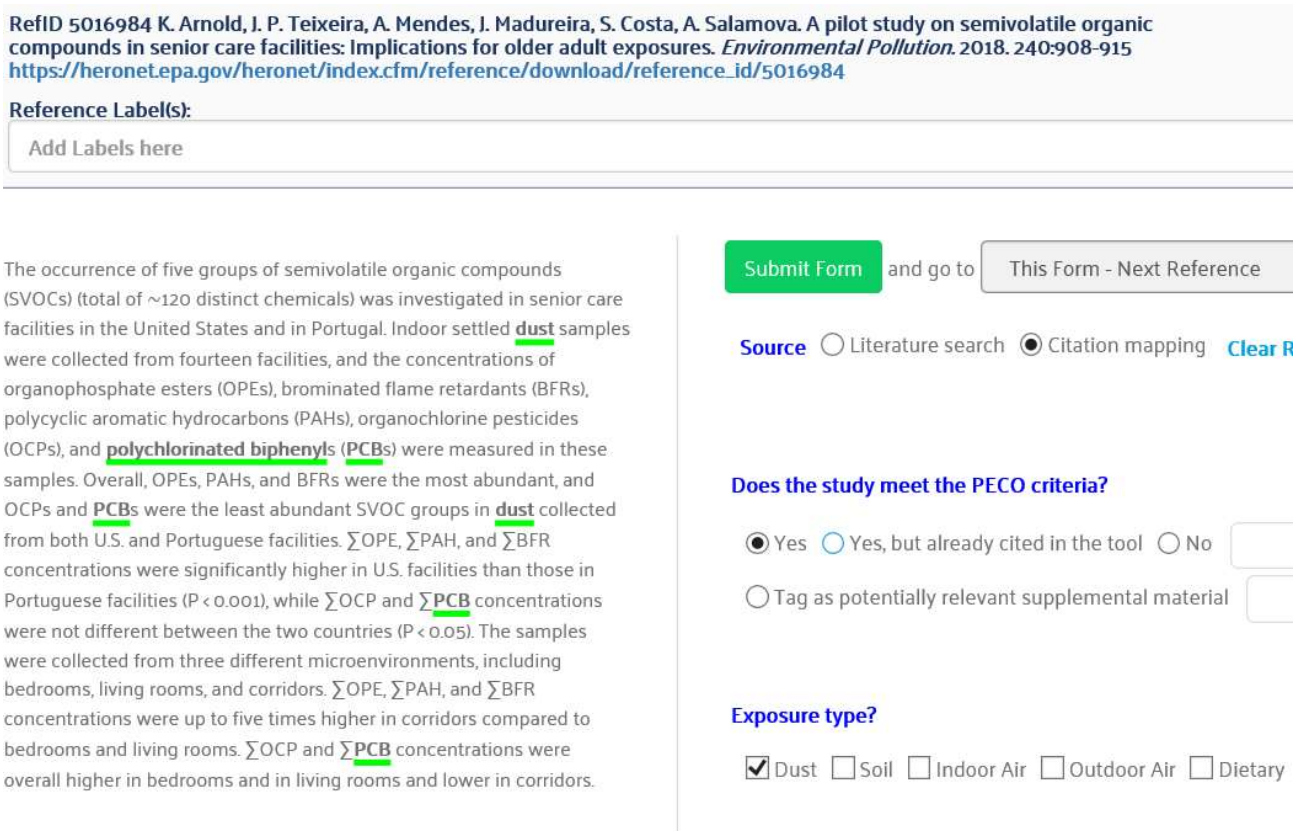

Figure 1. Screenshot of Distiller SR.

3.1.3 Full Text Review and Study Evaluation

For full-text screening, references that were identified as potentially relevant (i.e., tagged in Distiller SR as 'yes,' 'yes but already cited in the tool,' or 'unclear') were exported from Distiller SR into a spreadsheet with HERO IDs. This spreadsheet served as an evidence inventory and record of full-text decisions and data extraction. A copy of the spreadsheet is provided in Appendix D. Potentially relevant papers identified in the initial title/abstract screening process were obtained and the full text was reviewed by a single reviewer using the PECO requirements and the general assessment factors described below. Papers that were found to be useful for updating the Tool were tagged 'yes.' Studies that provided information that could be used for comparison purposes (e.g., data for a country other than the U.S.) were tagged 'supplemental.' Studies that were not relevant based on the PECO statement and/or did not meet the criteria described below were tagged 'no' and were not considered any further.

The U.S. EPA's Science Policy Council has recommended the following five General Assessment Factors (GAFs)[2] for evaluating scientific and technical information. The relevance of the papers obtained for this project were based on the professional judgement of the reviewers in consideration of these GAFs.

> ***Soundness*** − *The extent to which the scientific and technical procedures, measures, methods or models employed to generate the information are reasonable for, and consistent with, the intended application (e.g., standard collection and analytical methods; samples collected from background sites, adequate sample size,).*
>
> ***Applicability and Utility*** − *The extent to which the information is relevant for the Agency's intended use (e.g., representative of U.S. background conditions and total PCB concentrations; adequate number of congeners measured, data provided for the environmental media of interest in measurement units applicable to the Tool).*
>
> ***Clarity and Completeness*** − *The degree of clarity and completeness with which the data, assumptions, methods, quality assurance, sponsoring organizations and analyses employed to generate the information are documented (e.g., information provided on sampling conditions and analytical approaches; PCB congeners, homologues, or Aroclors measured; results reported as total PCB concentrations).*
>
> ***Uncertainty and Variability*** − *The extent to which the variability and uncertainty (quantitative and qualitative) in the information or in the procedures, measures, methods or models are evaluated and characterized (e.g., results reported as ranges, means, standard deviations).*
>
> ***Evaluation and Review*** − *The extent of independent verification, validation and peer review of the information or of the procedures, measures, methods or models (e.g., available in a peer-reviewed journal, available in English).*

4.0 Literature Search and Review Results

The literature search and citation mapping identified 3,046 records (duplicates removed) which were screened in Distiller SR (Figure 2). Of those, 2,814 were excluded because they were not relevant to the PECO, and 232 were retrieved for full text review. Based on the full-text review, an additional 164 records were excluded because they did not meet one or more of the GAFs (see Appendix D). The primary reason for exclusion was applicability and utility (e.g., limited

[2] U.S. Environmental Protection Agency (2003) A summary of general assessment factors for evaluating the quality of scientific and technical information. Science Policy Council, Washington, DC. EPA/100/B-03/001. Available online at: https://www.epa.gov/risk/summary-general-assessment-factors-evaluating-quality-scientific-and-technical-information.

number of congeners analyzed, not representative of background concentrations). Of the remaining 68 records, 9 studies provided useful information on U.S. background concentrations of PCBs in one or more of the media of interest, and could be used in updating the PCB Exposure Estimation Tool. Four studies provided information on dust, two provided information on soil; three provided information on indoor air, and two provided information on outdoor air (see Appendix E). An additional reference that provided information on indoor and outdoor air was identified in the targeted literature search, and two references that provided useful information on outdoor air were identified by reviewing the bibliographies cited in other papers. None of the papers that were reviewed provided relevant dietary data that could be used to update the Tool.

The remaining 59 papers provided supplementary information for one or more of the environmental media of interest (e.g., PCB background concentrations in non-U.S. locations) or were already cited in the PCB Exposure Estimation Tool. Five studies provided supplemental information on PCBs in dust, 31 provided supplemental information on PCBs in soil, six provided supplemental information on PCBs in indoor air, 22 provided supplemental information on PCBs in outdoor air, and 2 provided supplemental information on dietary exposure (see Appendix E).

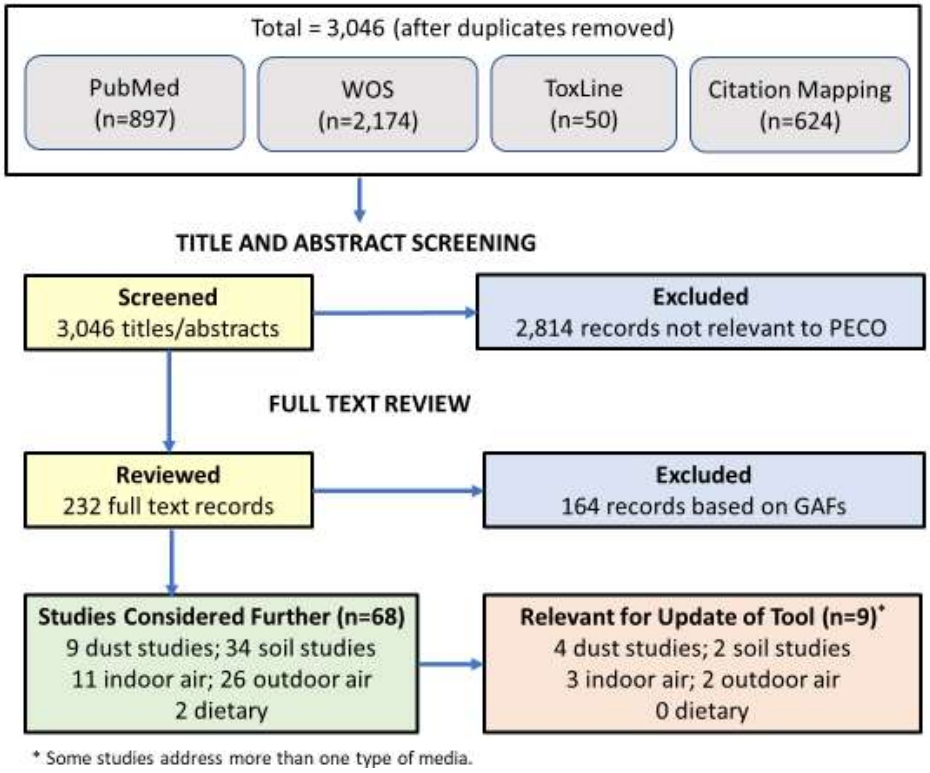

Figure 2. Literature Search and Review Results.

5.0 Updates to the PCB Exposure Estimation Tool

5.1 Environmental Media Concentrations

Appendix E provides a summary of the studies that were found to be useful for updating the tool, as well as studies that provided supplemental information (e.g., non-U.S. data). Table 3 provides a summary of the media concentrations used in the previous and updated versions of the PCB Exposure Estimation Tool.

5.1.1 Dust

Nine studies provided information on background PCB concentrations in dust. Four of these studies provided information for U.S. locations (see Table 3; three are new studies and one is the study used in the previous version of the Tool), and five of these studies provided information on non-U.S. locations (Table E-1 in Appendix E). The average of the central tendency values (means and geometric means) for the U.S. studies only is 0.27 µg/g. This value was used in the update to the PCB Exposure Estimation Tool. This value is similar to the background value for dust used in the original version of the Tool (0.22 µg/g). For comparison purposes, the average background concentration of PCBs in dust was also calculated using the average of the central tendency values from both the U.S. studies and supplemental non-U.S. studies (0.13 µg/g). Overall, concentrations reported in the various studies ranged from less than the limit of detection to 3.6 µg/g.

5.1.2 Soil

Thirty-four studies provided information on background PCB concentrations in soil. Two of these studies provided information for U.S. locations (See Table 3; the previous version of the Tool used data from a study in Finland and which was not used in this version of the Tool), and 32 of these studies provided information on non-U.S. locations (Table E-2 in Appendix E). The average of the central tendency values (means and geometric means) for the U.S. studies only is 0.06 µg/g. This value was used in the update to the PCB Exposure Estimation Tool. This value is similar to the background value for soil used in the original version of the Tool (0.05 µg/g). For comparison purposes, the average background concentration of PCBs in soil was also calculated using the average of the central tendency values from both the U.S. studies and supplemental non-U.S. studies (0.02 µg/g). Overall, concentrations reported in the various studies ranged from <0.00001 to 2.642 µg/g.

5.1.3 Indoor Air

Twelve studies provided information on background PCB concentrations in indoor air. Four of these studies (three from the literature search and 1 from the targeted internet search) provided

information for U.S. locations, and eight of these studies provided information on non-U.S. locations (Table E-3 in Appendix E). The average of the central tendency values (means and geometric means) for the U.S. studies only is 6.7 ng/m^3 (note that only 3 of the U.S studies provided central tendency values; one provided only a range; the study used in the previous version of the Tool was from Canada and was not used in calculating an average indoor air concentration for this version of the tool; See Table 3). This value was used in the update to the PCB Exposure Estimation Tool. This value is similar to the background value for indoor air used in the original version of the Tool (6.9 ng/m^3). For comparison purposes, the average background concentration of PCBs in indoor air was also calculated using the average of the central tendency values from both the U.S. studies and supplemental non-U.S. studies (7.2 ng/m^3). Overall, concentrations reported in the various studies ranged from less than the limit of quantification (LOQ) to 233 ng/m^3.

5.1.4 Outdoor Air

Twenty-nine studies provided information on background PCB concentrations in outdoor air. Five of these studies (two from the literature search and 3 from the targeted internet search and review of bibliographies in other studies) provided information for U.S. locations, and 24 of these studies provided information on non-U.S. locations (Table E-4 in Appendix E). The average of the central tendency values (means and geometric means) for the U.S. studies only is 0.53 ng/m^3 (note that the study used in the previous version of the Tool was from Canada and was not used in calculating an average indoor air concentration for this version of the tool; see Table 3). This value was used in the update to the PCB Exposure Estimation Tool. This value is similar to the background value for outdoor air used in the original version of the Tool (0.5 ng/m^3). For comparison purposes, the average background concentration of PCBs in outdoor air was also calculated using the average of the central tendency values from both the U.S. studies and supplemental non-U.S. studies (0.32 ng/m^3). Overall, concentrations reported in the various studies ranged from 0.0002 to 13.5 ng/m^3.

5.2 Dietary Exposure

The dietary exposure values used in Version 1.2 of the PCB Exposure Estimation Tool were provided by the U.S. Food and Drug Administration (FDA) and are based on Total Diet Study (TDS) data for foods collected in 2003. The information was provided by Katie Egan, FDA, in a personal communication to Linda Phillips, EPA, October 26, 2010 and in a memo from Judith Spungen to Linda Phillips, FDA, June 23, 2014. The TDS data represent dietary intake doses and are based on foods in which PCBs were detected. On February 5, 2019, Linda Phillips, EPA, contacted Judith Spungen, FDA, to inquire about whether more recent TDS exposure estimates for PCBs were available, and was informed that the 2003 TDS are still the most recent data set for PCBs. These total PCB dietary intake values range from 0.001 to 0.002 µg/kg/day, depending on the age group. More recent total PCB dietary exposure estimates for the U.S. population were not identified in the scientific literature. Thus, the exposure estimates from the

2003 FDA TDS were retained in the PCB Exposure Estimation Tool. Supplemental information from 2 studies (non-U.S. data for Belgium and Canada) reported total dietary exposures ranging from 0.003 to 0.01 µg/kg/day depending on the age group (Table E-5 in Appendix E).

5.3 Exposure Factors

The PCB Exposure Estimation Tool was developed in 2009, before the *Exposure Factors Handbook: 2011 Edition*[3] and its updates[4] were available. Thus, the exposure factors used in the original versions of the Tool were derived from data provided in the 1997 version of the *Exposure Factors Handbook*[5] and the 2008 *Child-specific Exposure Factors Handbook*[6]. Both of these documents have been superseded by the *Exposure Factors Handbook: 2011 Edition* and its updates. Updates to the PCB Exposure Estimation Tool were made using data from the *Exposure Factors Handbook: 2011 Edition* and its updates as shown in Table 4.

6.0 Updated Exposure Estimates and ELEs

As indicated in Section 4.0, the PCB Exposure Estimation Tool (Version 2.0) has been updated using the media concentrations identified in the systematic review of the literature and exposure factors from the *Exposure Factors Handbook: 2011 Edition* and its updates (Appendix F provides screenshots of the updated Tool). These revisions result in only small changes in the exposure estimates and maximum indoor air concentrations without exceeding the RfD for Aroclor 1254 (Table 5). Because the ELEs are based on the estimated maximum indoor air concentrations to which receptors could be exposed without exceeding the RfD, rounded to one significant figure[7], these revisions would result in no changes to the existing ELEs (Table 6) for all age groups except ages 6 to <12 years. For this age group, the updated ELE would be 400 ng/m^3 instead of 300 ng/m^3, when the maximum PCB concentration in indoor air is rounded to one significant figure (see Tables 5 and 6).

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[3] U.S. Environmental Protection Agency (2011) *Exposure Factors Handbook: 2011 Edition*. Office of Research and Development, Washington, DC. EPA/600/R-09/052F. Available at: https://www.epa.gov/expobox/about-exposure-factors-handbook.

[4] U.S. Environmental Protection Agency (2017) Update for Chapter 5 of the *Exposure Factors Handbook*. Office of Research and Development, Washington, DC. EPA/600/R-17/384F. Available at: https://www.epa.gov/expobox/about-exposure-factors-handbook.

[5] U.S. Environmental Protection Agency (2008) *Child-specific Exposure Factors Handbook*. Office of Research and Development, Washington, DC. EPA/600/R-06/096F. Available at: https://cfpub.epa.gov/ncea/efp/recordisplay.cfm?deid=199243.

[6] U.S. Environmental Protection Agency (1997) *Exposure Factors Handbook*. Office of Research and Development, Washington, DC. EPA/600/P-95/002Fa-c. Available at: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=12464.

[7] Because of the various uncertainties associated with the input values in the Tool (e.g., background media concentrations, exposure factors, RfD) maximum indoor air concentrations without exceeding the RfD were rounded to one significant figure to represent the ELEs.

Table 3. Media Concentrations in the Original and Updated PCB Exposure Estimation Tool		
Media	**Concentration**	**Basis**
Dust (µg/g)		
Previous concentration[a]	0.22	Harrad et al. (2009); mean sum of PCBs containing 3 to 7 chlorines from 20 homes in Texas = 0.22 µg/g
Updated concentration[b,c]	0.27	Arnold et al. (2018); geometric mean of 14 samples from 3 senior living facilities in Indiana; sum of 82 congeners = 0.092 µg/g Harrad et al. (2009); mean sum of PCBs containing 3 to 7 chlorines from 20 homes in Texas = 0.22 µg/g Hwang et al. (2008); mean of 10 apartments and 1 community hall in California; sum of 54 congeners = 0.075 µg/g Vorhees et al. (1999); geometric mean for homes (n=15) in Massachusetts; sum of 65 congeners = 0.69 µg/g
Soil (µg/g)		
Previous concentration[a]	0.05	Priha et al (2005); urban background concentration based on samples collected from parks in Helsinki, Finland = 0.05 µg/g
Updated concentration[b,d]	0.06	Martinez et al. (2012); mean of 64 samples from residential locations in Iowa; sum of 164 congeners = 0.056 µg/g Vorhees et al. (1999); geometric mean of 16 samples from residential homes in Massachusetts; sum of 65 congeners = 0.06 µg/g
Indoor Air (ng/m^3)		
Previous concentration[a]	6.9	Harrad et al. (2009); mean sum of PCBs containing 3 to 7 chlorines from 10 homes in Toronto, Canada = 6.9 ng/m^3
Updated concentration[b,e]	6.7	Ampleman et al. (2015); mean of geometric means for homes in Indiana (1.0 ng/m^3; n=34) and Iowa (0.44 ng/m^3; n=35), and schools in Indiana (6.4 ng/m^3; n=13) and Iowa (8.4 ng/m^3; n=11); total of 201 congeners Fitzgerald et al. (2011); mean of 176 samples collected from homes in New York; sum of 84 congeners = 14 ng/m^3 Vorhees et al. (1997); geometric mean of 16 homes in Massachusetts; total of 65 congeners = 10 ng/m^3 [g]
Outdoor Air (ng/m^3)		
Previous concentration[a]	0.51	Harrad et al. (2009); average total PCBs in outdoor air in Toronto, Canada = 0.51 ng/m^3
Updated concentration[b,f]	0.53	Marek et al. (2017); median values for outdoor air at 5 schools in Indiana and Iowa; sum of 209 congeners = 0.21, 0.584, 0.183, 0.36, 0.159 ng/m^3 Yan et al. (2008); data for a park (0.7 ng/m^3) and urban area (1.2 ng/m^3) in New Jersey; sum of 90 congeners Vorhees et al. (1997); geometric mean of 20 homes in Massachusetts; total of 65 congeners = 0.6 ng/m^3 [g] Hu et al. (2010); mean sum of 209 PCB congeners in 184 ambient air samples from 37 sites in Chicago, Illinois = 0.84 ng/m^3 [h] Palmer et al. (2008); median sum of 84 congeners for a comparison site in New York = 0.431 ng/m^3 (n=85) [h]

[a] PCB Exposure Estimation Tool, version 1.2
[b] PCB Exposure Estimation Tool, version 2.0.
[c] Average of values from 4 studies.
[d] Average of values from 2 studies.
[e] Average of values from 3 studies.
[f] Average of values from 5 studies.
[g] Identified in a targeted internet search (November 2018).
[h] Cited in another paper.

Table 4. Exposure Factors in the Original and Updated PCB Exposure Estimation Tool[a]							
Input Variable	**Age Group**						
	1-<2 years	**2-<3 years**	**3-<6 years**	**6-<12 years**	**12-<15 years**	**15-<19 years**	**19+ years**
Inhalation Rate (m^3/day)							
Previous exposure factor	8.0	9.5	10.9	12.4	15.1	16.5	15.9
Updated exposure factor	8.0	8.9	10.1	12.0	15.2	16.3	15.9
Soil Ingestion Rate (mg/day)							
Previous exposure factor	50	50	50	50	50	50	22.5
Updated exposure factor	40	30	30	30	10	10	10
Dust Ingestion Rate (mg/day)							
Previous exposure factor	60	60	60	60	60	60	27.5
Updated exposure factor	50	30	30	30	20	20	20
Adherence Factor (mg/cm^2-day)							
Previous exposure factor	0.006	0.006	0.006	0.005	0.005	0.005	0.003
Updated exposure factor	0.042[b]	0.038[b]	0.038[b]	0.005	0.006	0.005	0.003
Skin Surface Area (cm^2)							
Previous exposure factor	1,155	1,270	1,851	2,467	3,910	4,850	5,000
Updated exposure factor	1,155	1,365	1,714	2,553	3,852	4,427	4,991
Body Weight (kg)							
Previous exposure factor	11.4	13.8	18.6	31.8	56.8	71.6	71.8
Updated exposure factor	11.4	13.8	18.6	31.8	56.8	71.6	80.0

[a] Values for time spent indoors and outdoors, sleep time, and time spent in school were unchanged in Version 2.0.
[b] In the updated Tool, adherence factors for daycare children from Table 7-3 of the *Exposure Factors Handbook: 2011 Edition* were used for ages 1 to <6 years. These data are based on children ages 1 to 6.5 years. In the previous version of the tool, adherence values for residential children were used for this age group, but the underlying data were for children ages 3 to13 years. These updated values are more conservative than those used previously.

Table 5. Maximum PCB concentration (ng/m^3) in School Indoor Air without Exceeding RfD							
Input Variable	**Age Group**						
	1-<2 years	**2-<3 years**	**3-<6 years**	**6-<12 years**	**12-<15 years**	**15-<19 years**	**19+ years**
Existing PCB Exposure Estimation Tool (v1.2)	119	124	197	345	529	618	480
Updated PCB Exposure Estimation Tool (v2.0)	118	137	218	361	529	631	538

Table 6. Exposure Levels for Evaluating PCBs in Indoor School Air (ng/m^3) [a]							
Input Variable	**Age Group**						
	1-<2 years	**2-<3 years**	**3-<6 years**	**6-<12 years**	**12-<15 years**	**15-<19 years**	**19+ years**
Existing PCB Exposure Estimation Tool (v1.2)	100	100	200	300	500	600	500
Updated PCB Exposure Estimation Tool (v2.0)	100	100	200	400	500	600	500

[a] Values from Table 5 rounded to 1 significant figure in this Table.

7.0 References

ATSDR (2000) (Agency for Toxic Substances and Disease Registry) Toxicological Profile for PCBs. Available at: https://www.atsdr.cdc.gov/ToxProfiles/tp17.pdf .

Ampleman, MD; Martinez, A; Dewall, J; Rawn, DF; Hornbuckle, KC; Thorne, PC (2015) Inhalation and dietary exposure to PCBs in urban and rural cohorts via congener-specific measurements. Environmental Science and Technology. 49:1156-1164. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920071.

Arnold, K; Teixeira, JP; Mendes, A; Madureira, J; Costa, A; Salamova, A (2018) A pilot study on semivolatile organic compounds in senior care facilities: Implications for older adult exposures. Environmental Pollution. 240:908-915. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5016984.

Fitzgerald, EF; Shrestha, A; Palmer, PM; Wilson, LR; Belanger, EE; Gomez, MI; Cayo, MR; Hwang, SA (2011) Polychlorinated biphenyls (PCBs) in indoor air and in serum among older residents of upper Hudson River communities. Chemosphere. 85:225-231. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151223.

Harrad, S; Ibarra, C; Robson, M; Melymuk, L; Zhang, X; Diamond, M; Douwes, J (2009) Polychlorinated biphenyls in domestic dust from Canada, New Zealand, United Kingdom and United States: Implications for human exposure. Chemosphere. 76:232-238. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198193.

Hu, D; Lehmler, HJ; Martinez, A; Wang, K; Hornbuckle, KC (2010) Atmospheric PCB Congeners across Chicago. Atmospheric Environment. 44:1550-1557. https://www.sciencedirect.com/science/article/pii/S1352231010000324.

Hwang, HM; Park, EK; Young, TM; Hammock, BD (2008) Occurrence of endocrine-disrupting chemicals in indoor dust. Science of the Total Environment. 404:26-35. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198203.

Marek, RF; Thorne, PS; Herkert, NJ; Awad, AM; Hornbuckle, KC (2017) Airborne PCBs and OH-PCBs Inside and Outside Urban and Rural U.S. Schools. Environmental Science and Technology. 51:7853-7860. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3984192.

Martinez, A; Erdman, NR; Rodenburg, ZL; Eastling, PM; Hornbuckle, KC (2012) Spatial distribution of chlordanes and PCB congeners in soil in Cedar Rapids, Iowa, USA. Environmental Pollution. 161:222-228. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150856.

Palmer, PM; Belanger, EE; Wilson, LR; Hwang, SA; Narang, RS; Gomez, MI; Cayo, MR; Durocher, LA; Fitzgerald, EF (2008) Outdoor air PCB concentrations in three communities along the Upper Hudson River, New York. Arch. Environ. Contam. Toxicol. 54 (3), 363–371. https://link.springer.com/article/10.1007%2Fs00244-007-9035-z.

Priha, E; Hellman, S; Sorvari, J (2005) PCB contamination from polysulphide sealants in residential areas-exposure and risk assessment. Chemosphere. 59:537-43. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198230.

Vorhees, DJ; Cullen, AC; Altshul, LM (1997) Exposure to Polychlorinated Biphenyls in Residential Indoor Air and Outdoor Air near a Superfund Site. Environ. Sci. Technol., 1997, 31 (12), pp 3612–3618. DOI: 10.1021/es970371o. https://pubs.acs.org/doi/abs/10.1021/es970371o.

Vorhees, DJ; Cullen, AC; Altshul, LM (1999) Polychlorinated biphenyls in house dust and yard soil near a Superfund site. Environmental Science and Technology. 33:2151-2156. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2187227.

Yan, S; Rodenburg, LA; Dachs, J; Eisenreich, SJ (2008) Seasonal air-water exchange fluxes of polychlorinated biphenyls in the Hudson River Estuary. Environmental Pollution. 152:443-451. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2156999.

APPENDIX A – Literature Search Strings

PubMed: Dietary Exposure:

((((pcb[tw] OR pcb's[All Fields] OR "pcbs"[All Fields]) NOT ("printed circuit board"[All Fields] OR "printed circuit boards"[All Fields])) OR "polychlorinated biphenyl"[All Fields] OR "polychlorinated biphenyls"[All Fields] OR "aroclor"[All Fields] OR "aroclors"[All Fields] OR "arochlor"[All Fields] OR "arochlors"[All Fields] OR "chlophen"[All Fields] OR "chlorinated biphenyl"[All Fields] OR "chlorinated biphenyls"[All Fields] OR "chlorinated diphenyl"[All Fields] OR "chloro biphenyl"[All Fields] OR "chloro biphenyls"[All Fields] OR clophen[All Fields] OR "clophens"[All Fields] OR fenclor[All Fields] OR inerteen[All Fields] OR kanechlor[All Fields] OR "kanechlors"[All Fields] OR ("phenoclor"[Supplementary Concept] OR "phenoclor"[All Fields]) OR ("phenoclor"[Supplementary Concept] OR "phenoclor"[All Fields]) OR "polychlorobiphenyl"[All Fields] OR ("polychlorinated biphenyls"[MeSH Terms] OR ("polychlorinated"[All Fields] AND "biphenyls"[All Fields]) OR "polychlorinated biphenyls"[All Fields] OR "polychlorobiphenyl"[All Fields]) OR "pyralene"[All Fields] OR "pyranol"[All Fields] OR "sovol"[tw] OR "sovols"[All Fields] OR therminol[All Fields] OR "polychloro biphenyl"[All Fields] OR "polychloro biphenyls"[All Fields] OR "polychlorodiphenyls"[All Fields] OR "polychlorinated diphenyls"[All Fields] OR delor[tw] OR delors[tw] OR chlorofen[All Fields] OR monochlorobiphenyl[All Fields] OR monochlorobiphenyl[All Fields] OR chlorobiphenyl[All Fields] OR "chlorobiphenyls"[All Fields] OR chlorodiphenyl[All Fields] OR "chlorodiphenyls"[All Fields] OR monochlorodiphenyl[All Fields] OR dichlorobiphenyl[All Fields] OR dichlorobiphenyl[All Fields] OR dichlorodiphenyl[All Fields] OR "dichlorodiphenyls"[All Fields] OR "bichlorobiphenyls"[All Fields] OR trichlorobiphenyl[All Fields] OR trichlorobiphenyl[All Fields] OR trichlorobiphenyl[All Fields] OR "trichlorodiphenyls"[All Fields] OR tetrachlorobiphenyl[All Fields] OR tetrachlorobiphenyl[All Fields] OR tetrachlorobiphenyl[All Fields] OR "tetrachloro biphenyl"[All Fields] OR pentachlorobiphenyl[All Fields] OR pentachlorobiphenyl[All Fields] OR pentachlorobiphenyl[All Fields] OR "pentachloro biphenyl"[All Fields] OR hexachlorobiphenyl[All Fields] OR hexachlorobiphenyl[All Fields] OR "hexachloro biphenyl"[All Fields] OR "hexachloro biphenyls"[All Fields] OR ("2,3,4,5,3',4',5'-heptachlorobiphenyl"[Supplementary Concept] OR "2,3,4,5,3',4',5'-heptachlorobiphenyl"[All Fields] OR "heptachlorobiphenyl"[All Fields]) OR heptachlorobiphenyls[All Fields] OR octachlorobiphenyl[All Fields] OR octachlorobiphenyls[All Fields] OR nonachlorobiphenyls[All Fields] OR nonachlorobiphenyls[All Fields] OR ("decachlorobiphenyl"[Supplementary Concept] OR "decachlorobiphenyl"[All Fields]) OR decachlorobiphenyls[All Fields])) AND ("Dietary intake"[All Fields] OR "dietary exposure"[All Fields] OR "total diet"[All Fields] OR "dietary"[All Fields] OR "ingestion"[All Fields] OR "food"[All Fields]) NOT ("emissions"[All Fields] OR "emissions modelling"[All Fields] OR "physical-chemical"[All Fields] OR "color"[All Fields] OR "smell"[All Fields] OR "freezing point"[All Fields] OR "boiling point"[All Fields] OR "melting point"[All Fields] OR "opacity"[All Fields] OR "viscosity"[All Fields] OR "density"[All Fields] OR "electromotive force"[All Fields] OR "combustion"[All Fields] OR "reactivity"[All Fields] OR "sources"[All Fields] OR "fate"[All Fields] OR "toxicity"[All Fields] OR "dose-dependent"[All Fields] OR "threshold dose"[All Fields] OR "LD50"[All Fields] OR "human health effects"[All Fields] OR "dermal"[All Fields] OR "skin"[All Fields] OR "acne"[All Fields] OR "rash"[All Fields] OR "liver"[All Fields] OR "anemia"[All Fields] OR "stomach"[All Fields] OR "thyroid"[All Fields] OR "cancer"[All Fields] OR "carcinogen"[All Fields] OR "ecological effects"[All Fields] OR "degradability"[All Fields] OR "bioaccumulation"[All Fields] OR "sublethal"[All Fields] OR "synergistic"[All Fields] OR "reduced growth"[All Fields] OR "increased susceptibility"[All Fields]) AND ("2008/01/01"[PDAT] : "3000"[PDAT]))

PubMed: Media Concentrations

((((pcb[tw] OR pcb's[All Fields] OR "pcbs"[All Fields]) NOT ("printed circuit board"[All Fields] OR "printed circuit boards"[All Fields])) OR "polychlorinated biphenyl"[All Fields] OR "polychlorinated biphenyls"[All Fields] OR "aroclor"[All Fields] OR "aroclors"[All Fields] OR "arochlor"[All Fields] OR "arochlors"[All Fields] OR "chlophen"[All Fields] OR "chlorinated biphenyl"[All Fields] OR "chlorinated biphenyls"[All Fields] OR "chlorinated diphenyl"[All Fields] OR "chloro biphenyl"[All Fields] OR "chloro biphenyls"[All Fields] OR clophen[All Fields] OR "clophens"[All Fields] OR fenclor[All Fields] OR inerteen[All Fields] OR kanechlor[All Fields] OR "kanechlors"[All Fields] OR ("phenoclor"[Supplementary Concept] OR "phenoclor"[All Fields]) OR ("phenoclor"[Supplementary Concept] OR "phenoclor"[All Fields]) OR "polychlorobiphenyl"[All Fields] OR ("polychlorinated biphenyls"[MeSH Terms] OR ("polychlorinated"[All Fields] AND "biphenyls"[All Fields]) OR "polychlorinated biphenyls"[All Fields] OR "polychlorobiphenyl"[All Fields]) OR "pyralene"[All Fields] OR "pyranol"[All Fields] OR "sovol"[tw] OR "sovols"[All Fields] OR therminol[All Fields] OR "polychloro biphenyl"[All Fields] OR "polychloro biphenyls"[All Fields] OR "polychlorodiphenyls"[All Fields] OR "polychlorinated diphenyls"[All Fields] OR delor[tw] OR delors[tw] OR chlorofen[All Fields] OR monochlorobiphenyl[All Fields] OR monochlorobiphenyl[All Fields] OR chlorobiphenyl[All Fields] OR "chlorobiphenyls"[All Fields] OR chlorodiphenyl[All Fields] OR "chlorodiphenyls"[All Fields] OR monochlorodiphenyl[All Fields] OR dichlorobiphenyl[All Fields] OR dichlorobiphenyl[All Fields] OR dichlorodiphenyl[All Fields] OR "dichlorodiphenyls"[All Fields] OR "bichlorobiphenyls"[All Fields] OR trichlorobiphenyl[All Fields] OR trichlorobiphenyl[All Fields] OR trichlorobiphenyl[All Fields] OR "trichlorodiphenyls"[All Fields] OR tetrachlorobiphenyl[All Fields] OR tetrachlorobiphenyl[All Fields] OR tetrachlorobiphenyl[All Fields] OR "tetrachloro biphenyl"[All Fields] OR pentachlorobiphenyl[All Fields] OR pentachlorobiphenyl[All Fields] OR pentachlorobiphenyl[All Fields] OR "pentachloro biphenyl"[All Fields] OR hexachlorobiphenyl[All Fields] OR hexachlorobiphenyl[All Fields] OR "hexachloro biphenyl"[All Fields] OR "hexachloro biphenyls"[All Fields] OR ("2,3,4,5,3',4',5'-heptachlorobiphenyl"[Supplementary Concept] OR "2,3,4,5,3',4',5'-heptachlorobiphenyl"[All Fields] OR "heptachlorobiphenyl"[All Fields]) OR heptachlorobiphenyls[All Fields] OR octachlorobiphenyl[All Fields] OR octachlorobiphenyls[All Fields] OR nonachlorobiphenyls[All Fields] OR nonachlorobiphenyls[All Fields] OR ("decachlorobiphenyl"[Supplementary Concept] OR "decachlorobiphenyl"[All Fields]) OR decachlorobiphenyls[All Fields])) AND ("Concentration"[All Fields] OR "levels"[All Fields] OR "Soil"[All Fields] OR "soil ingestion"[All Fields] OR "Dust"[All Fields] OR "dust ingestion"[All Fields] OR "dust contact"[All Fields] OR "dust dermal"[All Fields] OR "Air"[All Fields] OR "inhalation"[All Fields] OR "inhalation exposure"[All Fields] OR "Indoor"[All Fields] OR "Residential"[All Fields] OR "homes"[All Fields] OR "apartments"[All Fields] OR "Buildings"[All Fields] OR "schools"[All Fields] OR "Outdoor"[All Fields] OR "Ambient"[All Fields]) NOT ("emissions"[All Fields] OR "emissions modelling"[All Fields] OR "physical-chemical"[All Fields] OR "color"[All Fields] OR "smell"[All Fields] OR "freezing point"[All Fields] OR "boiling point"[All Fields] OR "melting point"[All Fields] OR "opacity"[All Fields] OR "viscosity"[All Fields] OR "density"[All Fields] OR "electromotive force"[All Fields] OR "combustion"[All Fields] OR "reactivity"[All Fields] OR "sources"[All Fields] OR "fate"[All Fields] OR "toxicity"[All Fields] OR "dose-dependent"[All Fields] OR "threshold dose"[All Fields] OR "LD50"[All Fields] OR "human health effects"[All Fields] OR "dermal"[All Fields] OR "skin"[All Fields] OR "acne"[All Fields] OR "rash"[All Fields] OR "liver"[All Fields] OR "anemia"[All Fields] OR "stomach"[All Fields] OR "thyroid"[All Fields] OR "cancer"[All Fields] OR "carcinogen"[All Fields] OR "ecological effects"[All Fields] OR "degradability"[All Fields] OR "bioaccumulation"[All Fields] OR "sublethal"[All Fields] OR "synergistic"[All Fields] OR "reduced growth"[All Fields] OR "increased susceptibility"[All Fields]) AND ("2008/01/01"[PDAT] : "3000"[PDAT]))

WoS: Dietary Exposure

((((TS="pcb" OR TS="pcbs") NOT (TS="printed circuit board" OR TS="printed circuit boards")) OR TS="polychlorinated biphenyl" OR TS="polychlorinated biphenyls" OR TS="aroclor" OR TS="aroclors" OR TS="arochlor" OR TS="arochlors" OR TS="chlophen" OR TS="chlophens" OR TS="chlorinated biphenyl" OR TS="chlorinated biphenyls" OR TS="chlorinated diphenyl" OR TS="chlorinated diphenyls" OR TS="chloro biphenyl" OR TS="chloro biphenyls" OR TS="clophen" OR TS="clophens" OR TS="fenclor" OR TS="fenclors" OR TS="inerteen" OR TS="inerteens" OR TS="kanechlor" OR TS="kanechlors" OR TS="phenochlor" OR TS="phenochlors" OR TS="phenoclor" OR TS="phenoclors" OR TS="polychlorobiphenyl" OR TS="polychlorobiphenyls" OR TS="pyralene" OR TS="pyranol" OR TS="sovol" OR TS="sovols" OR TS="therminol" OR TS="therminols" OR TS="polychloro biphenyl" OR TS="polychloro biphenyls" OR TS="polychlorodiphenyls" OR TS="polychlorinated diphenyl" OR TS="polychlorinated diphenyls" OR TS="delor" OR TS="delors" OR TS="chlorofen" OR TS="chlorofens" OR TS="monochlorobiphenyl" OR TS="monochlorobiphenyls" OR TS="chlorobiphenyl" OR TS="chlorobiphenyls" OR TS="chlorodiphenyl" OR TS="chlorodiphenyls" OR TS="monochlorodiphenyl" OR TS="monochlorodiphenyls" OR TS="monochloro biphenyl" OR TS="monochloro biphenyls" OR TS="dichlorobiphenyl" OR TS="dichlorobiphenyls" OR TS="dichlorodiphenyl" OR TS="dichlorodiphenyls" OR TS="dichloro biphenyl" OR TS="dichloro biphenyls" OR TS="bichlorobiphenyl" OR TS="bichlorobiphenyls" OR TS="trichlorobiphenyl" OR TS="trichlorobiphenyls" OR TS="trichlorodiphenyl" OR TS="trichlorodiphenyls" OR TS="trichloro biphenyl" OR TS="trichloro biphenyls" OR TS="tetrachlorobiphenyl" OR TS="tetrachlorobiphenyls" OR TS="tetrachlorodiphenyl" OR TS="tetrachlorodiphenyls" OR TS="tetrachloro biphenyl" OR TS="tetrachloro biphenyls" OR TS="pentachlorobiphenyl" OR TS="pentachlorobiphenyls" OR TS="pentachlorodiphenyl" OR TS="pentachlorodiphenyls" OR TS="pentachloro biphenyl" OR TS="pentachloro biphenyls" OR TS="hexachlorobiphenyl" OR TS="hexachlorobiphenyls" OR TS="hexachloro biphenyl" OR TS="hexachloro biphenyls" OR TS="heptachlorobiphenyl" OR TS="heptachlorobiphenyls" OR TS="heptachloro biphenyl" OR TS="heptachloro biphenyls" OR TS="octachlorobiphenyl" OR TS="octachlorobiphenyls" OR TS="octachloro biphenyl" OR TS="octachloro biphenyls" OR TS="nonachlorobiphenyl" OR TS="nonachlorobiphenyls" OR TS="nonachloro biphenyl" OR TS="nonachloro biphenyls" OR TS="decachlorobiphenyl" OR TS="decachlorobiphenyls" OR TS="decachloro biphenyl" OR TS="decachloro biphenyls") AND (TS="Dietary intake" OR TS="dietary exposure" OR TS="total diet" OR TS="dietary" OR TS="ingestion" OR TS="food") NOT (TS="emissions" OR TS="emissions modelling" OR TS="physical-chemical" OR TS="color" OR TS="smell" OR TS="freezing point" OR TS="boiling point" OR TS="melting point" OR TS="opacity" OR TS="viscosity" OR TS="density" OR TS="electromotive force" OR TS="combustion" OR TS="reactivity" OR TS="sources" OR TS="fate" OR TS="toxicity" OR TS="dose-dependent" OR TS="threshold dose" OR TS="LD50" OR TS="human health effects" OR TS="dermal" OR TS="skin" OR TS="acne" OR TS="rash" OR TS="liver" OR TS="anemia" OR TS="stomach" OR TS="thyroid" OR TS="cancer" OR TS="carcinogen" OR TS="ecological effects" OR TS="degradability" OR TS="bioaccumulation" OR TS="sublethal" OR TS="synergistic" OR TS="reduced growth" OR TS="increased susceptibility") AND (PY=2008-2018))

WoS: Media Concentrations

((((TS="pcb" OR TS="pcbs") NOT (TS="printed circuit board" OR TS="printed circuit boards")) OR TS="polychlorinated biphenyl" OR TS="polychlorinated biphenyls" OR TS="aroclor" OR TS="aroclors" OR TS="arochlor" OR TS="arochlors" OR TS="chlophen" OR TS="chlophens" OR TS="chlorinated biphenyl" OR TS="chlorinated biphenyls" OR TS="chlorinated diphenyl" OR TS="chlorinated diphenyls" OR TS="chloro biphenyl" OR TS="chloro biphenyls" OR TS="clophen" OR TS="clophens" OR TS="fenclor" OR TS="fenclors" OR TS="inerteen" OR TS="inerteens" OR TS="kanechlor" OR TS="kanechlors" OR TS="phenochlor" OR TS="phenochlors" OR TS="phenoclor" OR TS="phenoclors" OR TS="polychlorobiphenyl" OR TS="polychlorobiphenyls" OR TS="pyralene" OR TS="pyranol" OR TS="sovol" OR TS="sovols" OR TS="therminol" OR TS="therminols" OR TS="polychloro biphenyl" OR TS="polychloro biphenyls" OR TS="polychlorodiphenyls" OR TS="polychlorinated diphenyl" OR TS="polychlorinated diphenyls" OR TS="delor" OR TS="delors" OR TS="chlorofen" OR TS="chlorofens" OR TS="monochlorobiphenyl" OR TS="monochlorobiphenyls" OR TS="chlorobiphenyl" OR TS="chlorobiphenyls" OR TS="chlorodiphenyl" OR TS="chlorodiphenyls" OR TS="monochlorodiphenyl" OR TS="monochlorodiphenyls" OR TS="monochloro biphenyl" OR TS="monochloro biphenyls" OR TS="dichlorobiphenyl" OR TS="dichlorobiphenyls" OR TS="dichlorodiphenyl" OR TS="dichlorodiphenyls" OR TS="dichloro biphenyl" OR TS="dichloro biphenyls" OR TS="bichlorobiphenyl" OR TS="bichlorobiphenyls" OR TS="trichlorobiphenyl" OR TS="trichlorobiphenyls" OR TS="trichlorodiphenyl" OR TS="trichlorodiphenyls" OR TS="trichloro biphenyl" OR TS="trichloro biphenyls" OR TS="tetrachlorobiphenyl" OR TS="tetrachlorobiphenyls" OR TS="tetrachlorodiphenyl" OR TS="tetrachlorodiphenyls" OR TS="tetrachloro biphenyl" OR TS="tetrachloro biphenyls" OR TS="pentachlorobiphenyl" OR TS="pentachlorobiphenyls" OR TS="pentachlorodiphenyl" OR TS="pentachlorodiphenyls" OR TS="pentachloro biphenyl" OR TS="pentachloro biphenyls" OR TS="hexachlorobiphenyl" OR TS="hexachlorobiphenyls" OR TS="hexachloro biphenyl" OR TS="hexachloro biphenyls" OR TS="heptachlorobiphenyl" OR TS="heptachlorobiphenyls" OR TS="heptachloro biphenyl" OR TS="heptachloro biphenyls" OR TS="octachlorobiphenyl" OR TS="octachlorobiphenyls" OR TS="octachloro biphenyl" OR TS="octachloro biphenyls" OR TS="nonachlorobiphenyl" OR TS="nonachlorobiphenyls" OR TS="nonachloro biphenyl" OR TS="nonachloro biphenyls" OR TS="decachlorobiphenyl" OR TS="decachlorobiphenyls" OR TS="decachloro biphenyl" OR TS="decachloro biphenyls") AND (TS="Concentration" OR TS="levels" OR TS="Soil" OR TS="soil ingestion" OR TS="Dust" OR TS="dust ingestion" OR TS="dust contact" OR TS="dust dermal" OR TS="Air" OR TS="inhalation" OR TS="inhalation exposure" OR TS="Indoor" OR TS="Residential" OR TS="homes" OR TS="apartments" OR TS="Buildings" OR TS="schools" OR TS="Outdoor" OR TS="Ambient") NOT (TS="emissions" OR TS="emissions modelling" OR TS="physical-chemical" OR TS="color" OR TS="smell" OR TS="freezing point" OR TS="boiling point" OR TS="melting point" OR TS="opacity" OR TS="viscosity" OR TS="density" OR TS="electromotive force" OR TS="combustion" OR TS="reactivity" OR TS="sources" OR TS="fate" OR TS="toxicity" OR TS="dose-dependent" OR TS="threshold dose" OR TS="LD50" OR TS="human health effects" OR TS="dermal" OR TS="skin" OR TS="acne" OR TS="rash" OR TS="liver" OR TS="anemia" OR TS="stomach" OR TS="thyroid" OR TS="cancer" OR TS="carcinogen" OR TS="ecological effects" OR TS="degradability" OR TS="bioaccumulation" OR TS="sublethal" OR TS="synergistic" OR TS="reduced growth" OR TS="increased susceptibility") AND (PY=2008-2018))

ToxNet: Dietary Exposure

@AND+@OR+(@TERM+@rn+"35065+30+6"+@TERM+@rn+"52663+71+5"+@TERM+@rn+"52663+74+8"+@TERM+@rn+"68194+16+1"+@TERM+@rn+"38411+25+5"+@TERM+@rn+"40186+70+7"+@TERM+@rn+"52663+65+7"+@TERM+@rn+"52663+70+4"+@TERM+@rn+"52663+67+9"+@TERM+@rn+"52663+64+6"+@TERM+@rn+"35065+29+3"+@TERM+@rn+"74472+47+2"+@TERM+@rn+"60145+23+5"+@TERM+@rn+"52663+69+1"+@TERM+@rn+"74472+48+3"+@TERM+@rn+"52712+05+7"+@TERM+@rn+"74472+49+4"+@TERM+@rn+"52663+68+0"+@TERM+@rn+"74487+85+7"+@TERM+@rn+"39635+31+9"+@TERM+@rn+"41411+64+7"+@TERM+@rn+"74472+50+7"+@TERM+@rn+"74472+51+8"+@TERM+@rn+"69782+91+8"+@TERM+@rn+"35694+08+7"+@TERM+@rn+"52663+78+2"+@TERM+@rn+"42740+50+1"+@TERM+@rn+"33091+17+7"+@TERM+@rn+"68194+17+2"+@TERM+@rn+"52663+75+9"+@TERM+@rn+"52663+73+7"+@TERM+@rn+"40186+71+8"+@TERM+@rn+"2136+99+4"+@TERM+@rn+"52663+76+0"+@TERM+@rn+"74472+52+9"+@TERM+@rn+"74472+53+0"+@TERM+@rn+"40186+72+9"+@TERM+@rn+"52663+79+3"+@TERM+@rn+"52663+77+1")+@OR+("dietary+intake"+"dietary+exposure"+"total+diet"+dietary+ingestion+food)+@RANGE+yr+2008+2018+@NOT+@org+pubmed+pubdart+nih

@AND+@OR+("polychlorinated+biphenyl"+"polychlorinated+biphenyls"+aroclor+aroclors+arochlor+arochlors+chlophen+chlophens+"chlorinated+biphenyl"+"chlorinated+biphenyls"+"chlorinated+diphenyl"+"chlorinated+diphenyls"+"chloro+biphenyl"+"chloro+biphenyls"+fenclor+fenclors+inerteen+inerteens+kanechlor+kanechlors+phenochlor+phenochlors+phenoclor+phenoclors+polychlorobiphenyl+polychlorobiphenyls+pyralene+pyranol+sovol+sovols+therminol+therminols+"polychloro+biphenyl"+"polychloro+biphenyls"+polychlorodiphenyls+"polychlorinated+diphenyl"+"polychlorinated+diphenyls"+delor+delors+chlorofen+chlorofens+monochlorobiphenyl+monochlorobiphenyls+chlorobiphenyl+chlorobiphenyls+chlorodiphenyl+chlorodiphenyls+monochlorodiphenyl+monochlorodiphenyls+"monochloro+biphenyl"+"monochloro+biphenyls")+@OR+("dietary+intake"+"dietary+exposure"+"total+diet"+dietary+ingestion+food)+@RANGE+yr+2008+2018+@NOT+@org+pubmed+pubdart+nih

@AND+@OR+("biphenyl+chloride"+"biphenyl+chlorides"+dichlorobiphenyl+dichlorobiphenyls+dichlorodiphenyl+dichlorodiphenyls+"dichloro+biphenyl"+"dichloro+biphenyls"+bichlorobiphenyl+bichlorobiphenyls+trichlorobiphenyl+trichlorobiphenyls+trichlorodiphenyl+trichlorodiphenyls+"trichloro+biphenyl"+"trichloro+biphenyls"+tetrachlorobiphenyl+tetrachlorobiphenyls+tetrachlorodiphenyl+tetrachlorodiphenyls+"tetrachloro+biphenyl"+"tetrachloro+biphenyls"+pentachlorobiphenyl+pentachlorobiphenyls+pentachlorodiphenyl+pentachlorodiphenyls+"pentachloro+biphenyl"+"pentachloro+biphenyls"+hexachlorobiphenyl+hexachlorobiphenyls+"hexachloro+biphenyl"+"hexachloro+biphenyls"+heptachlorobiphenyl+heptachlorobiphenyls+"heptachloro+biphenyl"+"heptachloro+biphenyls"+octachlorobiphenyl+octachlorobiphenyls+"octachloro+biphenyl"+"octachloro+biphenyls"+nonachlorobiphenyl+nonachlorobiphenyls+"nonachloro+biphenyl"+"nonachloro+biphenyls"+decachlorobiphenyl+decachlorobiphenyls+"decachloro+biphenyl"+"decachloro+biphenyls")+@OR+("dietary+intake"+"dietary+exposure"+"total+diet"+dietary+ingestion+food)+@RANGE+yr+2008+2018+@NOT+@org+pubmed+pubdart+nih

Toxnet: Media Concentrations

@AND+@OR+(@TERM+@rn+"35065+30+6"+@TERM+@rn+"52663+71+5"+@TERM+@rn+"52663+74+8"+@TERM+@rn+"68194+16+1"+@TERM+@rn+"38411+25+5"+@TERM+@rn+"40186+70+7"+@TERM+@rn+"52663+65+7"+@TERM+@rn+"52663+70+4"+@TERM+@rn+"52663+67+9"+@TERM+@rn+"52663+64+6"+@TERM+@rn+"35065+29+3"+@TERM+@rn+"74472+47+2"+@TERM+@rn+"60145+23+5"+@TERM+@rn+"52663+69+1"+@TERM+@rn+"74472+48+3"+@TERM+@rn+"52712+05+7"+@TERM+@rn+"74472+49+4"+@TERM+@rn+"52663+68+0"+@TERM+@rn+"74487+85+7"+@TERM+@rn+"39635+31+9"+@TERM+@rn+"41411+64+7"+@TERM+@rn+"74472+50+7"+@TERM+@rn+"74472+51+8"+@TERM+@rn+"69782+91+8"+@TERM+@rn+"35694+08+7"+@TERM+@rn+"52663+78+2"+@TERM+@rn+"42740+50+1"+@TERM+@rn+"33091+17+7"+@TERM+@rn+"68194+17+2"+@TERM+@rn+"52663+75+9"+@TERM+@rn+"52663+73+7"+@TERM+@rn+"40186+71+8"+@TERM+@rn+"2136+99+4"+@TERM+@rn+"52663+76+0"+@TERM+@rn+"74472+52+9"+@TERM+@rn+"74472+53+0"+@TERM+@rn+"40186+72+9"+@TERM+@rn+"52663+79+3"+@TERM+@rn+"52663+77+1")+@OR+(concentration+levels+soil+"soil+ingestion"+dust+"dust+ingestion"+"dust+contact"+"dust+dermal"+air+inhalation+"inhalation+exposure"+indoor+residential+homes+apartments+buildings+schools+outdoor+ambient)+@RANGE+yr+2008+2018+@NOT+@org+pubmed+pubdart+nih

@AND+@OR+("polychlorinated+biphenyl"+"polychlorinated+biphenyls"+aroclor+aroclors+arochlor+arochlors+chlophen+chlophens+"chlorinated+biphenyl"+"chlorinated+biphenyls"+"chlorinated+diphenyl"+"chlorinated+diphenyls"+"chloro+biphenyl"+"chloro+biphenyls"+fenclor+fenclors+inerteen+inerteens+kanechlor+kanechlors+phenochlor+phenochlors+phenoclor+phenoclors+polychlorobiphenyl+polychlorobiphenyls+pyralene+pyranol+sovol+sovols+therminol+therminols+"polychloro+biphenyl"+"polychloro+biphenyls"+polychlorodiphenyls+"polychlorinated+diphenyl"+"polychlorinated+diphenyls"+delor+delors+chlorofen+chlorofens+monochlorobiphenyl+monochlorobiphenyls+chlorobiphenyl+chlorobiphenyls+chlorodiphenyl+chlorodiphenyls+monochlorodiphenyl+monochlorodiphenyls+"monochloro+biphenyl"+"monochloro+biphenyls")+@OR+(concentration+levels+soil+"soil+ingestion"+dust+"dust+ingestion"+"dust+contact"+"dust+dermal"+air+inhalation+"inhalation+exposure"+indoor+residential+homes+apartments+buildings+schools+outdoor+ambient)+@RANGE+yr+2008+2018+@NOT+@org+pubmed+pubdart+nih

@AND+@OR+("biphenyl+chloride"+"biphenyl+chlorides"+dichlorobiphenyl+dichlorobiphenyls+dichlorodiphenyl+dichlorodiphenyls+"dichloro+biphenyl"+"dichloro+biphenyls"+bichlorobiphenyl+bichlorobiphenyls+trichlorobiphenyl+trichlorobiphenyls+trichlorodiphenyl+trichlorodiphenyls+"trichloro+biphenyl"+"trichloro+biphenyls"+tetrachlorobiphenyl+tetrachlorobiphenyls+tetrachlorodiphenyl+tetrachlorodiphenyls+"tetrachloro+biphenyl"+"tetrachloro+biphenyls"+pentachlorobiphenyl+pentachlorobiphenyls+pentachlorodiphenyl+pentachlorodiphenyls+"pentachloro+biphenyl"+"pentachloro+biphenyls"+hexachlorobiphenyl+hexachlorobiphenyls+"hexachloro+biphenyl"+"hexachloro+biphenyls"+heptachlorobiphenyl+heptachlorobiphenyls+"heptachloro+biphenyl"+"heptachloro+biphenyls"+octachlorobiphenyl+octachlorobiphenyls+"octachloro+biphenyl"+"octachloro+biphenyls"+nonachlorobiphenyl+nonachlorobiphenyls+"nonachloro+biphenyl"+"nonachloro+biphenyls"+decachlorobiphenyl+decachlorobiphenyls+"decachloro+biphenyl"+"decachloro+biphenyls")+@OR+(concentration+levels+soil+"soil+ingestion"+dust+"dust+ingestion"+"dust+contact"+"dust+dermal"+air+inhalation+"inhalation+exposure"+indoor+residential+homes+apartments+buildings+schools+outdoor+ambient)+@RANGE+yr+2008+2018+@NOT+@org+pubmed+pubdart+nih

Additional Exclusions:

Wildlife:
rat|rodent|mice|wildlife|foxes|polar bears|zebrafish|flounder|marine life|whales|aquatic birds|seabirds|loons|seal|sea turtles|osprey|pelagic foodweb|marine foodweb|aquatic foodweb|fungi|gulls|sea lion|zooplankton|cats|dogs|pets

PBDEs:
PBDEs|Polybrominated Diphenyl Ethers|PCDEs|Polychlorinated Diphenyl Ethers|organochlorine pesticides|insecticides|PCDD|PCDF|pyrethroid|heavy metals|DDT|HCH|flame retardants

Sediment:
sediment|microbial|microbiota|bacteria|clinical|effluent|sewage|sewage sludge|stormwater|wastewater|bioassay|immunoassay|viruses|disease|biotransformation

APPENDIX B – References Used in Citation Mapping

Brunciak, P.A.; Lavorgna, C.L.; Nelson, E.D.; et al. (1999) Trends and dynamics of persistent organic pollutants in the coastal atmosphere of the mid-Atlantic states. Prepr Ext Abst Div Environ Chem Am Chem Soc 39(1):64-67

Coghlan, K.M.; Chang, M.P.; Jessup, D.S.; Fragala, M.A.; McCrillis, K.; Lockhart, T.M. (2002) Characterization of Polychlorinated biphenyls in building materials and exposures in the indoor environment. Proceeding: Indoor Air, 2002.

Currado, G.M. and Harrad, S. (1998) Comparison of Polychlorinated biphenyl concentrations in indoor and outdoor air and the potential significance of inhalation as a human exposure pathway. Environ. Sci. Technol. 32(20)3043-3047.

Harrad, S.; Ibarra, C.; Robson, M.; Melymuk, L.; Zhang, X.; Diamond, M.; Douwes, J., 2009. PCBs in domestic dust from Canada, New Zealand, UK and US: Implications for human exposure. Chemosphere: in press).

Herrick, R.F.; McClean, M.D.; Meeker, J.D.; Baxter, L.K.; Weymouth, G.A., 2004. An unrecognized source of PCB contamination in schools and other buildings. Env Health Per 112:1051-1053.

Meijer, S.N.; Ockenden, W.A.; Sweetman, A., et al. (2003) Global distribution and budget of PCBs and HCB in background surface soils; implications for sources and environmental processes. Environm. Sci. Technol. 37:667-672.

Priha, E.; Hellman, S.; Sorvani, J., 2005. PCB contamination from polysulfide sealants in residential areas - exposure and risk assessment. Chemosphere 59:537-543.

Vorhees, D.J.; Cullen, A.C.; Altshul, L.M. (1999). Polychlorinated biphenyls in house dust and yard soil near a Superfund site. Environ Sci Technol 33:2151-2156. (as cited in ATSDR, 2000).

APPENDIX C – Targeted Internet Search Results

Citation	How identified	Relevant?	Why or why not?
Indoor air			***The background value in the current Tool is 6.9 ng/m^3***
Ampleman, MD; Martinez, A; DeWall, J; Rawn, DFK; Hornbuckle, KC: Thorne, PS (2015) Inhalation and Dietary Exposure to PCBs in Urban and Rural Cohorts via Congener-Specific Measurements. Environ. Sci. Technol. 49: 1156−1164	Internet search November 2018	Yes	Geometric mean (SE) ΣPCB indoor air concentrations were 1.0 (0.02) ng/m^3 for East Chicago, Indiana homes and 0.44 (0.1) ng/m^3 for Columbus Junction, Iowa homes. Arithmetic mean ΣPCB indoor air concentrations were 6.4 ± 0.1 ng/m^3, n = 13 at East Chicago schools and 8.4 ± 0.4 ng/m^3, n=11 for Columbus Junction schools.
Bräuner, EV; Andersen, ZJ; Frederiksen, M; Specht, IO; Hougaard, KS; Ebbehøj, N; Bailey, J; Giwercman, A; Steenland, K; Longnecker, MP; Bonde, JP (2016) Health Effects of PCBs in Residences and Schools (HESPERUS): PCB – health Cohort Profile. Scientific Reports | 6:24571 | DOI: 10.1038/srep24571.	Internet search November 2018	No	Provides indoor air data for contaminated sites, but also provides reference values ranging from 4 (US school) to 53 (Denmark school) ng/m^3.
Corner, R; Sundahl, M; Rosell, L; Ek-Olausson, B; Tysklind, M (2002) PCB in Indoor Air and Dust in Buildings in Stockholm. Proceeding Indoor Air 2002.	Internet search November 2018	No	Proceedings only. Provides indoor air data for contaminated sites in Sweden, but also provides reference values ranging from 0 to 31 ng/m^3.
Dai, Q; Min, X; Weng; M (2016) A review of polychlorinated biphenyls (PCBs) pollution in indoor air environment, Journal of the Air & Waste Management Association, 66:10, 941-950, DOI: 10.1080/10962247.2016.1184193.	Internet search November 2018	No, see primary references	Review of several other papers, including Fitzgerald et al. (2011) and some older papers.
Fitzgerald, EF; Shrestha, S; Palmer, PM; Wilson, LR; Belanger, EE; Gomez, MI; Cayo, MR; Hwang, S (2011) Polychlorinated biphenyls (PCBs) in indoor air and in serum among older residents of upper Hudson River communities. Chemosphere 85:225-231.	Internet search November 2018	Yes	The mean indoor air PCB concentration for 176 homes (92 from the study area and 84 from the comparison site) in upper Hudson River communities was 14 ng/m^3, ranging from 0.6 to 233 ng/m^3. Since the PCB levels between the study and comparison areas did not differ significantly the results from both areas were combined.
Frederiksen, M; Meyer, HW; Ebbehøj, NE; Gunnarsen, L (2012) Polychlorinated biphenyls (PCBs) in indoor air originating from sealants in contaminated and uncontaminated apartments within the same housing estate. Chemosphere 89 (2012) 473–479.	Internet search November 2018	Maybe	Provides indoor air data for contaminated apartments in Denmark, but also provides reference value of 6.03 ng/m^3.
Heinzow, B; Mohr, S; Ostendorp, G; Kerst K; Ko¨rner, W (2007) PCB and dioxin-like PCB in indoor air of public buildings contaminated with different PCB sources – deriving toxicity equivalent concentrations from standard PCB congeners. Chemosphere 67: 1746–1753	Internet search November 2018	No	Samples collected from buildings in Germany suspected of having PCB sources; adjusted median background concentration of 15 ng/m^3 total PCBs. Note that they cite a German guideline level (similar to ELE) of 300 ng/m^3.
Herrick, RF; McClean, MD; Meeker, JD; Baxter, LK; Weymouth, GA, 2004. An unrecognized source of PCB contamination in schools and other buildings. Env Health Per 112:1051-1053.	Internet search November 2018	No	Already cited in Tool to provide data on contaminated buildings; not background.

Citation	How identified	Relevant?	Why or why not?
Marek, RF; Thorne, PS; Herkert, NJ; Awad, AM; Hornbuckle, KC (2017) Airborne PCBs and OH-PCBs Inside and Outside Urban and Rural U.S. School. Environ. Sci. Technol. 51, 7853−7860.	Internet search November 2018	Yes	Evaluated indoor and outdoor air concentrations of PCBs from two rural schools and four urban schools, the latter near a PCB-contaminated waterway of Lake Michigan. Concentrations of ΣPCBs ranged from 0.5 to 194 ng/m^3 indoors.
Okun, JD; Rezendes, A; Occhialini, J (2012) How Overly Cautious Risk Assessment Methods Overstate Risk from PCBs in Indoor Air. Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy: Vol. 17 , Article 6. Available at: http://scholarworks.umass.edu/soilsproceedings/vol17/iss1/6	Internet search November 2018	No	No background data
Schultz, TJ (2012) Comparison of PCBs in East Chicago, Indiana and Columbus Junction, Iowa in indoor and outdoor air. Master's thesis. University of Iowa. Available at: https://ir.uiowa.edu/cgi/viewcontent.cgi?article=3127&context=etd.	Internet search November 2018	See Ampleman et al., 2015	Master's thesis. Evaluated indoor and outdoor air concentrations of PCBs from two locations: East Chicago, IN and Columbus Junction, IA. Mean indoor concentrations were 1.9 (n=68) and 3.9 (n=65) ng/m^3 for these locations, respectively.
Vorhees, DJ; Cullen, AC; Altshul, LM (1997) Exposure to Polychlorinated Biphenyls in Residential Indoor Air and Outdoor Air near a Superfund Site. Environ. Sci. Technol., 1997, 31 (12), pp 3612–3618. DOI: 10.1021/es970371o	Internet search November 2018	Yes	Indoor and outdoor air samples were collected from homes near a contaminated site (New Bedford Harbor, MA), and comparison homes. The geometric mean concentrations for the comparison homes were 10 ng/m^3 indoors (n=16; range=5.2-51 ng/m^3) and 0.6 ng/m^3 outdoors (n=20; range=0.1-8.2 ng/m^3), based on the sum of 65 congeners.
Washington State (2011) King County Alder Tower Polychlorinated Biphenyls (PCBs) Caulking. Seattle, King County, Washington. Letter Health Consultation. Prepared by The Washington State Department of Health Under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry. DOH 334-274 July 2011.	Internet search November 2018	No	Data from building with potential sources of PCBs.
Outdoor Air			***The background value in the current Tool is 0.5 ng/m^3.***
Colombo, A; Benfenati, E; Bugatti, SG; Lodi, M; Mariani, A; Musmerci, L; Rotella, G; Senese, V; Ziemacki, G; Fanelli, A (2013) PCDD/Fs and PCBs in ambient air in a highly industrialized city in Northern Italy. Chemosphere. 90: 2352-2357.	Internet search February 2019	No	Samples collected near PCB production plant.
Fitzgerald, EF; Shrestha, S; Palmer, PM; Wilson, LR; Belanger, EE; Gomez, MI; Cayo, MR; Hwang, S (2011) Polychlorinated biphenyls (PCBs) in indoor air and in serum among older residents of upper Hudson River communities. Chemosphere 85:225-231.	Internet search November 2018	See primary references	Cites a previous study (Palmer et al., 2008) in which PCBs were measured in ambient air at a contaminated and reference site. The PCB concentrations outside 85 residences at the reference site ranged from 0.08 to 2.37 ng/m^3 with a median of 0.43 ng/m^3.
Glüge, J; Bogdal, C; Scheringer, M; Hungerbühler, K (2016) What determines PCB concentrations in soils in rural and urban areas? Insights from a multi-media fate model for Switzerland as a case study. Science of the Total Environment 550: 1152–1162.	Internet search November 2018	No	Emissions modeling; individual congeners.

Citation	How identified	Relevant?	Why or why not?
Hu, D; Lehmler, HJ; Martinez, A; Wang, K; Hornbuckle, KC (2010) Atmospheric PCB Congeners across Chicago. Atmospheric Environment. 44:1550-1557.	Cited in Colombo et al., 2013	Yes	Measured all 209 PCB congeners in 184 ambient air samples from 37 sites in Chicago. The sum of PCBs ranged from 0.075 to 5.5 ng/m^3 with a mean of 0.84 ng/m^3.
Li, Y; Harner, T; Liu, L; Zhang, Z; Ren, N; Jia, H; Ma, J; Sverko, E (2010)Polychlorinated Biphenyls in Global Air and Surface Soil: Distributions, Air-Soil Exchange, and Fractionation Effect. Environ. Sci. Technol. 44, 2784–2790	Internet search November 2018	Maybe	Provides background concentrations for various geographic regions (ng/m^3): 0.070 (0.0051-0.17) for Europe, 0.079 (0.049-0.12) for North America, 0.066 (0.018-0.110) for South America, 0.270 (0.009-0.67) for Central America, 0.059 (0.017-0.15) for Asia, and 0.015 (0.013-0.017) for Australia.
Marek, RF; Thorne, PS; Herkert, NJ; Awad, AM; Hornbuckle, KC (2017) Airborne PCBs and OH-PCBs Inside and Outside Urban and Rural U.S. School. Environ. Sci. Technol. 51, 7853−7860.	Internet search November 2018	Yes	Evaluated indoor and outdoor air concentrations of PCBs from two rural schools and four urban schools, the latter near a PCB-contaminated waterway of Lake Michigan. Concentrations of ΣPCBs ranged from 0.03 to 3 ng/m^3 outdoors.
Palmer, PM; Belanger, EE; Wilson, LR; Hwang, SA; Narang, RS; Gomez, MI; Cayo, MR; Durocher, LA; Fitzgerald, EF (2008) Outdoor air PCB concentrations in three communities along the Upper Hudson River, New York. Arch. Environ. Contam. Toxicol. 54 (3), 363–371.	Cited in Fitzgerald et al., 2011	Yes	Total PCB concentrations (sum of 84 congeners) in the study (contaminated) area ranged from 0.102 to 4.011 ng/m^3 (median: 0.711 ng/m3) and 0.080 to 2.366 ng/m^3 (median: 0.431 ng/m^3) for the comparison area (n=85; Glen Falls, NY).
Schultz, TJ (2012) Comparison of PCBs in East Chicago, Indiana and Columbus Junction, Iowa in indoor and outdoor air. Master's thesis. University of Iowa. Available at: https://ir.uiowa.edu/cgi/viewcontent.cgi?article=3127&context=etd.	Internet search November 2018	No, see Ampleman et al., 2015	Master's thesis. Evaluated indoor and outdoor air concentrations of PCBs from two locations: East Chicago, IN and Columbus Junction, IA. Mean outdoor concentrations were 0.62 (n=67) and 1.3 (n=68) ng/m^3, respectively.
Vorhees, DJ; Cullen, AC; Altshul, LM (1997) Exposure to Polychlorinated Biphenyls in Residential Indoor Air and Outdoor Air near a Superfund Site. Environ. Sci. Technol., 1997, 31 (12), pp 3612–3618. DOI: 10.1021/es970371o	Internet search November 2018	Yes	Indoor and outdoor air samples were collected from homes near a contaminated site (New Bedford Harbor, MA), and comparison homes. The geometric mean concentrations for the comparison homes were 10 ng/m^3 indoors (n=16; range=5.2-51 ng/m^3) and 0.6 ng/m^3 outdoors (n=20; range=0.1-8.2 ng/m^3).
Dust			***The background value in the current Tool is 0.22 µg/g.***
Corner, R; Sundahl, M; Rosell, L; Ek-Olausson, B; Tysklind, M (2002) PCB in Indoor Air and Dust in Buildings in Stockholm. Proceeding Indoor Air 2002.	Internet search November 2018	No	Proceedings only. Provides dust data for contaminated sites in Sweden, but also provides reference values ranging from 0.06 to 1.8 µg/g.
DellaValle, CT; Wheeler, DC; Deziel, NC; De Roos, AJ; Cerhan, JR; Cozen, W; Severson, RK; Flory, AR; Locke, SJ; Colt, JS; Hartge, P; Ward; MH (2013) Environmental determinants of polychlorinated biphenyl concentrations in residential carpet dust. Environ Sci Technol. 2013 September 17; 47(18): 10405–10414. doi:10.1021/es401447w.	Internet search November 2018	No	Dust collected from homes in Detroit, Los Angeles, Seattle, Iowa. 5 PCB congeners measured. Median congener concentrations ranged from 1.9 to 11.6 ng/g.
Gonzalez, J; Feng, L; Sutherland, A; Waller, C; Sok, H; Hesse, R; Rosenfeld, P (2011) PCBs and dioxins/furans in attic dust collected near former PCB production and secondary copper facilities in Sauget, IL. Procedia Environmental Sciences 4: 113–125.	Cited in Kumar et al., 2014	No	Data for attic dust near a contaminated site. Mean total PCBs was 5 (0.2-43.5) µg/g.

Citation	How identified	Relevant?	Why or why not?
Hinwood, AL; Callan, AC; Heyworth, J; Rogic, D; de Araujo, J; Crough, R; Mamahit, G; Piro, N; Yates, A; Stevenson, G; Odland, JO (2014) Polychlorinated biphenyl (PCB) and dioxin concentrations in residential dust of pregnant women. Environ. Sci.: Processes Impacts, 16: 2758-2763.	Internet search November 2018	No	Dioxin-like PCBs only
Knobeloch, L; Turyk, M; Imm, P; Anderson, H (2012) Polychlorinated biphenyls in vacuum dust and blood of residents in 20 Wisconsin Households. Chemosphere 86: 235-240.	Provided by an internal EPA reviewer	No	While it is not entirely clear in the paper, it appears that the total PCB values are based only on the congeners that were also found in the serum of the residents, representing only 21 PCB peaks of the 62 PCB peaks detected.
Larsson, K; Berglund, M (2018) Children's exposure to chemicals in indoor environments - a literature survey of chemicals in dust. Institute for Environmental Medicine, Stockholm, Sweden.	Internet search February 2019	No	Review of literature. Range from 8 studies is 0.0063 to 0.260 µg/g; midpoint is 0.133.
Washington State (2011) King County Alder Tower Polychlorinated Biphenyls (PCBs) Caulking. Seattle, King County, Washington. Letter Health Consultation. Prepared by The Washington State Department of Health Under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry. DOH 334-	Internet search November 2018	No	Data from building with potential sources of PCBs.
Whitehead, TP; Brown, FR; Metayer, C; Park, J; Does, M; Dhaliwal, J; Petreas, MX: Buffler, PA; Rappaport SM (2014) Polychlorinated Biphenyls in Residential Dust: Sources of Variability. Environ. Sci. Technol.48: 157−164.	Internet search November 2018	No	15 individual congeners; not total PCBs
Soil			***The background value in the current Tool is 0.05 µg/g.***
Ge, J; Woodward, LA; Li, QX; Wang, J (2013) Distribution, Sources and Risk Assessment of Polychlorinated Biphenyls in Soils from the Midway Atoll, North Pacific Ocean. PLoS ONE 8(8): e71521. doi:10.1371/journal.pone.0071521.	Cited in Kumar et al., 2014	No	The total concentrations of the 28 indicator PCBs (ΣPCBs) ranged from 0.0026 to 0.1488 µg/g with an average of 0.0507 µg/g and median of 0.0395 µg/g, and the highest value of 0.1488 µg/g was found at B8-5 site
Glüge, J; Bogdal, C; Scheringer, M; Hungerbühler, K (2016) What determines PCB concentrations in soils in rural and urban areas? Insights from a multi-media fate model for Switzerland as a case study. Science of the Total Environment 550: 1152–1162.	Internet search November 2018	No	Emissions modeling; individual congeners.
Gonzalez, J; Feng, L; Sutherland, A; Waller, C; Sok, H; Hesse, R; Rosenfeld, P (2011) PCBs and dioxins/furans in attic dust collected near former PCB production and secondary copper facilities in Sauget, IL. Procedia Environmental Sciences 4: 113–125.	Cited in Kumar et al., 2014	No	Data for soil near a contaminated site. Mean total PCBs 0.487 µg/g.
Herrick, RF; Lefkowitz, DJ; Weymouth, GA (2007) Soil Contamination from PCB-Containing Buildings. Environ Health Perspect 115:173–175.	Internet search November 2018	No	Soil concentration associated with contaminated buildings. Soil concentration associated with contaminated buildings.

Citation	How identified	Relevant?	Why or why not?
Kim, AW; Vane, CH; Moss-Hayes, VL; Berriro, DJ (2018) Polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in urban soils of Glasgow, UK. Earth and Environmental Science Transactions of The Royal Society of Edinburgh. https://doi.org/10.1017/S1755691018000324	Internet search February 2019	No	Abstract only. Concentrations in near surface soils in Scotland. Mean total PCBs (tri-hepta) was 0.0324 µg/g.
Kumar, B; Verma, VK; Singh, SK; Kumar, S; Sharma, CS; Akolkar, AB (2014) Polychlorinated biphenyls in residential soils and their health risk and hazard in an industrial city in India. Journal of Public Health Research. 3:252.	Internet search November 2018	Maybe, but see primary references.	Provides a summary of data for various countries. See references 36, 37, and 38 from this paper for the original US data: Gonzalez et al. 2011; Martinez et al. 2012; Ge et al. 2013. Mean values cited from those US refs are 0.487 (industrialized), 0.056 (garden), and 0.0507 (military) µg/g.
Li, Y; Harner, T; Liu, L; Zhang, Z; Ren, N; Jia, H; Ma, J; Sverko, E (2010) Polychlorinated Biphenyls in Global Air and Surface Soil: Distributions, Air-Soil Exchange, and Fractionation Effect. Environ. Sci. Technol. 44, 2784–2790	Internet search November 2018	No	Provides average soil concentrations (µg/g dry weight) for PCBs at background sites: 0.0075 for Europe, 0.0043 (0.00011-0.025) for North America, 0.0014 for South America, 0.0058 for Asia, 0.00390 for Africa, and 0.0028 for Australia.
Martinez, A; Erdman, NR; Rodenburg, ZL; Eastling, PM; Hornbuckle, KC (2012) Spatial distribution of chlordanes and PCB congeners in soil in Cedar Rapids, Iowa, USA. Environmental Pollution 161: 222-228.	Cited in Kumar et al., 2014	Yes	"Residential soils from Cedar Rapids, Iowa, USA were collected and analyzed for chlordanes and polychlorinated biphenyls (PCBs). This study is one of the very few urban soil investigations in the USA....ΣPCB concentrations ranged from 0.003 to 1.2 µg/g dw, with a mean and standard deviation of 0.056 ± 0.160 µg/g dw and are about 10 times higher than world-wide background levels." The median value was 0.020 µg/g.
UKSHS Report Number 8. (2007) UK Soil and Herbage Pollutant Survey. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291162/scho0607bmtb-e-e.pdf	Internet search November 2018	Maybe	"Soil and herbage samples collected from rural, urban and industrial sites in England, Northern Ireland, Scotland and Wales (n = 203) were analyzed for 26 selected PCBs in the largest national survey ever carried out on these persistent organic pollutants (POPs)...The levels of ΣPCB (sum of 26 congeners) ranged from 0.00022 to 0.0628 µg/g with a mean of 0.00202 µg/g and a median value of 0.00101 µg/g."
Diet			***The background values in the Tool are 0.002 ug/kg-d for ages 1 to <6 years and 0.001 ug/kg-day for ages 6+ years.***
Ampleman, MD; Martinez, A; DeWall, J; Rawn, DFK; Hornbuckle, KC: Thorne, PS (2015) Inhalation and Dietary Exposure to PCBs in Urban and Rural Cohorts via Congener-Specific Measurements. Environ. Sci. Technol. 49: 1156−1164	Internet search November 2018	No	Uses dietary data from older Canadian Total Diet Studies; dietary exposure estimated to be 66-108 µg/yr for children and 74-83 µg/year for mothers; this would be equivalent to about 0.006-0.01 µg/kg-d for a 30 kg child and 0.003 µg/kg-day for a 70 kg adult based on EPA calculations (see Figure 4 pie charts in paper).
Barone, G; Storelli, A; Garofalo, R; Mallamaci, R; Quaglia, NC; Storelli, MM (2018) PCBs and PCDD/Fs in Bluefin Tuna: Occurrence	Internet search November 2018	No	Dietary intake based on selected congeners in tuna.

Citation	How identified	Relevant?	Why or why not?
and Dietary Intake. Int. J. Environ. Res. Public Health 2018, 15, 911; doi:10.3390/ijerph15050911			
Bramwell, L; Mortimer, D; Rose, M; Fernandes, A; Harrad, S; Pless-Mulloli, T (2017) UK dietary exposure to PCDD/Fs, PCBs, PBDD/Fs, PBBs and PBDEs: comparison of results from 24-h duplicate diets and total diet studies. Food Additives & Contaminants: Part A 34(1), 65-77.	Internet search November 2018	No	Estimated dietary intake using data for 6 PCB congeners from the UK total diet study (TDS) and duplicate diet (DD) analysis. "The average adult dietary exposure to the non-dioxin-like ICES-6 PCBs was estimated to be 1.80 pg/kg/d by the TDS and 0.58 by the DD."
Chung, SWC; Lau, JSY; Ch, JYK (2018) Dietary exposure to non-dioxin-like PCBs of the Hong Kong adult population from a total diet study. Journal Food Additives & Contaminants: Part A Volume 35, 2018 - Issue 3; https://www.tandfonline.com/doi/abs/10.1080/19440049.2017.1411616	Internet search November 2018	No	Abstract only; estimates based on Hong Kong's total diet study for 6 indicator PCBs; "the lower bound and upper bound exposure estimates of Σ6 PCBs to the average consumer of the population were found to be 0.00068 and 0.00138 µg/kg/day respectively
Lee, J; Lee, H; Kim, D; Yon, M; Nam, J; Kwon, S; Choi, A; Chang, Y; Shin, E; Baek, O; Suh, J; Park, S; Kim, C (2014) Total dietary exposure of PCBs in Koreans and related socio-demographic factors. FASEB abstract number 813.9. https://www.fasebj.org/doi/abs/10.1096/fasebj.28.1_supplement.813.9	Internet search November 2018	No	Abstract only; estimates based on Korean total diet study; "mean PCBs exposure of the Korean population was estimated to be 6.04±0.04 ng/kg bw/day" (0.006 µg/kg-day).
Miscellaneous			***ELEs range from 100-600 ng/m^3 depending on age group.***
Herrick, RF; Stewart, JH; Allen, JG (2016) Review of PCBs in US Schools: A Brief History, Estimate of the Number of Impacted Schools, and an Approach for Evaluating Indoor Air Samples. Environ Sci Pollut Res Int. 23(3): 1975–1985.	Internet search November 2018	No	Discusses EPA's PCB Exposure Estimation Tool.
MacIntosh, DL; Minegishi, T; Allen, JA; Levin-Schwartz, Y; McCarthy, JF; Stewart, JH; Coghlan, KM (no date) Risk Assessment for PCBs in Indoor Air of Schools. http://www.isiaq.org/docs/presentations/1102_MacIntosh.pdf.	Internet search November 2018	No	Use of the PCB Exposure Estimation Tool to develop site-specific ELEs; "The methodological foundation for this analysis follows the general approach developed by USEPA to derive suggested levels for PCBs in indoor air of schools (USEPA, 2009)...For children less than 6 years of age, target schoolyear average concentrations for PCBs in indoor air of a class room in our study ranged from 230 ng/m^3 to 990 ng/m^3. In comparison, the U.S. Environmental Protection Agency (USEPA) recommends a concentration of 100 ng/m^3 for this age group in a "generic school"."
Site-Specific Assessment for PCBs Estabrook School Lexington, MA (2011) https://lps.lexingtonma.org/cms/lib/MA01001631/Centricity/Domain/547/health/Final%20Site-Specific%20Assessment.pdf	Internet search November 2018	No	Use of the PCB Exposure Estimation Tool to develop site-specific ELEs.
Vermont (2013) PCBs in Indoor Air of Schools, Development of Recommended Concentrations. http://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_PR_PCBsSchools.pdf	Internet search November 2018	No	Use of the PCB Exposure Estimation Tool to develop site-specific ELEs.

APPENDIX D - Results of Full-Text Review

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2187227	RefID 2187227 D. J. Vorhees, A. C. Cullen, L. M. Altshul. Polychlorinated biphenyls in house dust and yard soil near a Superfund site. Environmental Science and Technology. 1999. 33:2151-2156 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2187227	✓	✓				Yes			Data for U.S. background location; multiple congeners measured	--	Soil and house dust collected from 19 homes surrounding New Bedford Harbor, MA (contaminated site) during sediment dredging operations and at 15 comparison sites; analyzed for 65 PCB congeners in 1994-1995; in the comparison sites, concentrations of the sum of congeners in dust ranged from 0.26 to 3.6 µg/g dw (geometric mean = 0.69 µg/g); concentrations in soil ranged from 0.015 to 0.29 µg/g dw (geometric mean = 0.06 µg/g); concentrations in harbor neighborhoods significantly higher.
198241	RefID 198241 H. Takigami, G. Suzuki, Y. Hirai, S. Sakai. Brominated flame retardants and other polyhalogenated compounds in indoor air and dust from two houses in Japan. Chemosphere. 2009. 76:270-277 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198241	✓		✓	✓				Supplemental	Non-US data, but multiple congeners measured	--	Samples collected at 2 homes in Japan; provides results for mono- through deca chlorinated biphenyls; dust concentrations = 0.015 and 0.022 µg/g (n=2); outdoor air concentrations = 0.24 and 0.73 ng/m^3 (n=2); indoor air concentrations = 0.73-1.5 ng/m^3 (n=4).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
5017651	RefID 5017651 O. Audy, L. Melymuk, M. Venier, S. Vojta, J. Becanova, K. Romanak, M. Vykoukalova, R. Prokes, P. Kukucka, M. L. Diamond, J. Klanova. PCBs and organochlorine pesticides in indoor environments - A comparison of indoor contamination in Canada and Czech Republic. Chemosphere. 2018. 206:622-631 https://heronet.epa.gov/heronet/index.cfm/reference/downl/oad/reference_id/5017651	✓		✓				No		Limited number of congeners analyzed	Applicability and Utility	Indoor air samples collected from 23 homes in Canada (n=35 samples) and 20 homes (n=30 samples) in the Czech Republic in 2013; floor dust samples also collected; analyzed for 7 indicator PCBs (28, 52, 101, 118, 138, 153, 180); concentrations of the sum of PCBs ranged from 0.139 to 4.23 ng/m^3 (median = 0.467 ng/m^3) in the Czech Republic homes and 0.109 to 5.11 ng/m^3 (median = 0.455 ng/m^3) in the Canadian homes; lower chlorinated congeners (28, 52) generally dominated; PCBs found in 45% of Canadian dust samples and most of Czech Republic dust samples; concentrations of PCBs in dust ranged from 0.0114 to 0.358 µg/g (median = 0.0751 µg/g, mean = 0.0793 ± 0.0208 µg/g) in Czech Republic dust, and <LOD to 0.521 µg/g (median = <LOD, mean = 0.0691 ± 0.0394 µg/g) in Canadian dust.
198193	RefID 198193 S. Harrad, C. Ibarra, M. Robson, L. Melymuk, X. Zhang, M. Diamond, J. Douwes. Polychlorinated biphenyls in domestic dust from Canada, New Zealand, United Kingdom and United States: Implications for human exposure. Chemosphere. 2009. 76:232-238 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198193	✓		✓	✓				Already in Tool	--	--	Dust collected from 20 homes in Austin Texas, 20 homes in Birmingham, UK, 10 homes in Toronto, Canada, and 20 homes in Wellington, New Zealand; analyzed for congeners containing 3-7 chlorines; mean total PCB concentration in dust samples collected was 0.22 µg/g (range = 0.047 to 0.62 µg/g) in TX, 0.11 µg/g (range = 0.0057-0.86 µg/g) in UK, 0.29 µg/g (range = 0.056-0.82 µg/g) in Canada, and 0.067 (range = 0.011-0.26 µg/g) in New Zealand; profile indicated that PCBs 1254, 1260, and 1242 dominated; mean total PCB concentration (3-7 chlorines) in air from 10 homes in Toronto, Canada was 6.9 ng/m^3 (range = 1.1 to 14.4 ng/m^3; 95th percentile = 14.2 ng/m^3); cites data from Motelay-Massei et al., 2005 for outdoor air PCB concentrations from Toronto which ranged from 0.1 to 1.4 ng/m^3 with a mean of 0.51 ng/m^3.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
1082315	RefID 1082315 G. H. Xing, Y. Liang, L. X. Chen, S. C. Wu, M. H. Wong. Exposure to PCBs, through inhalation, dermal contact and dust ingestion at Taizhou, China--a major site for recycling transformers. Chemosphere. 2011. 83:605-611 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1082315	✓			✓			No for dust	Supplemental for Outdoor Air	Not representative of indoor dust	Applicability and Utility	Data for outdoor air and outdoor dust from contaminated and 2 reference locations in China; analyzed for 37 PCB congeners; total PCBs in outdoor air were 0.46 ng/m^3; total PCBs in outdoor dust were 42.2 ng/g dw (0.042 µg/g).
2185312	RefID 2185312 Y. Su, H. Hung. Inter-laboratory comparison study on measuring semi-volatile organic chemicals in standards and air samples. Environmental Pollution. 2010. 158:3365-3371 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2185312	✓			✓			No		No new data on PCBs in dust or outdoor air	Applicability and Utility	Measurements of semi-volatile organic chemicals (SVOCs) including PCBs were compared among 21 laboratories from 7 countries through the analysis of standards, a blind sample, an air extract, and an atmospheric dust sample; no new data.
1056024	RefID 1056024 F. Mercier, P. Glorennec, O. Thomas, B. Le Bot. Organic contamination of settled house dust, a review for exposure assessment purposes. Environmental Science and Technology. 2011. 45:6716-6727 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1056024	✓						No		No new data on PCBs in dust	Applicability and Utility	Focused on sources, contamination and measurement methods for dust; no data.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
1076646	RefID 1076646 S. Harrad, E. Goosey, J. Desborough, M. A. Abdallah, L. Roosens, A. Covaci. Dust from U.K. primary school classrooms and daycare centers: the significance of dust as a pathway of exposure of young U.K. children to brominated flame retardants and polychlorinated biphenyls. Environmental Science and Technology. 2010. 44:4198-4202 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1076646	✓						No		Limited number of congeners analyzed	Applicability and Utility	Sum of 8 congeners in UK classroom dust; n=36; pattern most like Aroclor 1242; mean = 0.041 µg/g PCBs; range = 0.0012 to 0.56 µg/g; 50th percentile = 0.015 µg/g; 95th percentile=0.094 µg/g.
1927567	RefID 1927567 N. M. Tue, S. Takahashi, G. Suzuki, T. Isobe, P. H. Viet, Y. Kobara, N. Seike, G. Zhang, A. Sudaryanto, S. Tanabe. Contamination of indoor dust and air by polychlorinated biphenyls and brominated flame retardants and relevance of non-dietary exposure in Vietnamese informal e-waste recycling sites. Environment International. 2013. 51:160-167 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1927567	✓							Supplemental	Non-US data, but multiple congeners measured	--	Evaluated house dust samples from e-waste recycling sites and control non-waste sites in urban and suburban Viet Nam; analyzed for 62 PCB congeners; total PCBs ranged from 0.0036 to 0.02 with a median of 0.0054 µg/g at control suburban sites (n=7) and 0.0056 to 0.085 with a median of 0.010 µg/g at control urban sites (n=6).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198203	RefID 198203 H. M. Hwang, E. K. Park, T. M. Young, B. D. Hammock. Occurrence of endocrine-disrupting chemicals in indoor dust. Science of the Total Environment. 2008. 404:26-35 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198203	✓					Yes			Data for U.S. background location; multiple congeners measured	--	Collected dust samples from vacuum cleaner bags from 10 apartments and 1 community hall in California; analyzed for 54 congeners; sum of PCBs in dust ranged from <0.01 to 0.57 µg/g (mean = 0.075 µg/g).
198523	RefID 198523 J. Tan, S. M. Cheng, A. Loganath, Y. S. Chong, J. P. Obbard. Selected organochlorine pesticide and polychlorinated biphenyl residues in house dust in Singapore. Chemosphere. 2007. 68:1675-1682 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198523	✓							Supplemental	Non-US data, but multiple congeners measured	--	PCBs in house dust from 31 homes in Singapore; mean sum of 41 congeners = 0.0092 ± 0.011 µg/g; median = 0.0056 µg/g; range = <LOD to 0.044 µg/g.
2149869	RefID 2149869 W. Wang, M. J. Huang, J. S. Zheng, K. C. Cheung, M. H. Wong. Exposure assessment and distribution of polychlorinated biphenyls (PCBs) contained in indoor and outdoor dusts and the impacts of particle size and bioaccessibility. Science of the Total Environment. 2013. 463-464:1201-1209 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149869	✓							Supplemental	Non-US data, but multiple congeners measured	--	120 outdoor dust and 40 indoor dust samples collected from homes in 2 cities in China; concentrations of the sum of 37 PCB congeners in indoor samples ranged from 0.0174 to 0.264 µg/g (mean values for the 2 cities were 0.0818 and 0.139 µg/g); outdoor dust concentrations ranged from 0.00402 to 0.228 µg/g (mean values for the 2 cities were 0.0466 and 0.0376 µg/g).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2150926	RefID 2150926 N. Ali, N. Van den Eede, A. C. Dirtu, H. Neels, A. Covaci. Assessment of human exposure to indoor organic contaminants via dust ingestion in Pakistan. Indoor Air. 2012. 22:200-211 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150926	✓						No		Limited number of congeners analyzed	Applicability and Utility	Dust samples collected from rural homes (n=31) and mosques (n=12) in Gujrat, Pakistan in 2011; analyzed for 6 indicator PCBs (28, 52, 101, 138, 153, 180); median sum of PCBs were <0.001 µg/g in both homes and mosques; in homes the concentrations ranged from 0.0003 to 0.0061 µg/g (mean = 0.00075 ug/g, median = 0.00067 µg/g); highest concentrations were observed in houses built before 1970 and lowest in houses built after 1980s; PCB 153 dominated.
2151541	RefID 2151541 T. Whitehead, C. Metayer, P. Buffler, S. M. Rappaport. Estimating exposures to indoor contaminants using residential dust. Journal of Exposure Science and Environmental Epidemiology. 2011. 21:549-564 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151541	✓						No		No new data on PCBs in dust	Applicability and Utility	Review of literature on dust ingestion as a pathway of exposure to PCBs and other compounds, sources of PCBs in dust, and other factors; data are summarized for 5 PCB congeners from various studies/countries.
2153153	RefID 2153153 L. Roosens, M. A. Abdallah, S. Harrad, H. Neels, A. Covaci. Current exposure to persistent polychlorinated biphenyls (PCBs) and dichlorodiphenyldichloroethylene (p,p'-DDE) of Belgian students from food and dust. Environmental Science and Technology. 2010. 44:2870-2875 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153153	✓				✓		No		Limited number of congeners analyzed	Applicability and Utility	Estimated exposure to PCBs from diet and dust among 19 'background-exposed' Belgian students (20-25 years of age); based on measured 5 PCB congeners in food and dust; sum of PCBs in dust ranged from 0.0065 to 0.0419 (median = 0.0172) µg/g dw; most abundant congeners were 138-153 > 118 > 180 > 170, with 138 and 153 major contributors to total PCBs; dietary intake ranged from 40 to 204 ng/day (about 0.0006 to 0.003 µg/kg/day for a 70 kg adult.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2157723	RefID 2157723 O. D. Christopoulou, V. A. Sakkas, T. A. Albanis. Evaluation of matrix solid-phase dispersion extraction for the determination of polycyclic aromatic hydrocarbons in household dust with the aid of experimental design and response surface methodology. Journal of Separation Science. 2012. 35:3554-3560 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2157723	✓						No		No new data on PCBs in dust	Applicability and Utility	Method for the determination of PAHs in dust; not PCBs.
2188026	RefID 2188026 T. P. Whitehead, M. H. Ward, J. S. Colt, M. G. Nishioka, P. A. Buffler, S. M. Rappaport, C. Metayer. Determinants of polychlorinated biphenyls in dust from homes in California, USA. Environmental Science: Processes & Impacts. 2013. 15:339-346 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2188026	✓						No		Limited number of congeners analyzed	Applicability and Utility	Dust samples collected from 415 homes in California in 2001-2006; analyzed for 6 PCB congeners (105, 118, 138, 153, 170, 180); concentrations of individual congeners ranged from non-detect to 0.27 µg/g; statistics for sum of PCBs not provided.
2533249	RefID 2533249 B. L. Wang, S. T. Pang, J. P. Sun, X. L. Zhang, X. L. Li, Y. G. Sun, X. M. Lu, Q. Zhang. Levels of polychlorinated biphenyls in settled house dust from urban dwellings in China and their neurodevelopmental effects on preschool-aged children. Science of the Total Environment. 2015. 505:402-	✓							Supplemental	Non-US data, but multiple congeners measured	--	Settled house dust collected from 114 homes in China in 2011; analyzed for 39 PCB congeners; all 39 congeners detected; median total PCB concentration was 0.0732 µg/g (range = 0.01 to 0.667 µg/g; mean = 0.11 µg/g); di-, tetra-, and tri-congeners dominated.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	408 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2533249											
2533328	RefID 2533328 T. P. Whitehead, S. Crispo Smith, J. S. Park, M. X. Petreas, S. M. Rappaport, C. Metayer. Concentrations of persistent organic pollutants in California women's serum and residential dust. Environmental Research. 2014. 136C:57-66 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2533328	✓						No		No new data on PCBs in dust	Applicability and Utility	Evaluated relationships between PCB concentrations in blood and other factors, including PCBs in house dust; dust samples were collected from 48 participants' vacuum cleaners and analyzed for 15 PCB congeners; no significant correlation was observed between dust and serum PCBs for the major congeners; levels of PCBs in dust not reported.
2534297	RefID 2534297 O. A. Abafe, B. S. Martincigh. Polybrominated diphenyl ethers and polychlorinated biphenyls in indoor dust in Durban, South Africa. Indoor Air. 2014. 25:547-556 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2534297	✓						No		Limited number of congeners analyzed	Applicability and Utility	Indoor dust samples collected from homes (n=10), offices (n=11), and university students' computer labs (n=13) in Durban, South Africa in 2012; analyzed for 3 PCB congeners (28, 153, 180); PCBs detected in 9 of 10 homes, 8 of 11 offices, and 12 of 13 computer labs; mean concentrations of the sum of 3 congeners were 0.891 (median = 0.724, range = <LOD to 2.2) µg/g in homes, 0.923 (median = 1.04, range = <LOD to 2.05) µg/g in offices, and 1.88 (median = 0.36, range = <LOD to 19.1) µg/g in computer labs; when 1 outlier was removed from the computer lab samples, the mean was 0.446 (median = 0.353, maximum = 1.56) µg/g; PCB 180 was the most abundant congener.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2539110	RefID 2539110 T. P. Whitehead, C. Metayer, M. H. Ward, J. S. Colt, R. B. Gunier, N. C. Deziel, S. M. Rappaport, P. A. Buffler. Persistent organic pollutants in dust from older homes: learning from lead. American Journal of Public Health. 2014. 104:1320-1326 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2539110	✓						No		No new data on PCBs in dust	Applicability and Utility	Evaluated the relationship between home age and levels of contaminants (including PCBs) in dust; collected dust samples in 583 homes between 2001 and 2007; reported on observed relationship between age and dust concentrations, but PCB concentrations in dust not reported in this paper.
2539595	RefID 2539595 B. Wang, X. Zhang, Q. Zhang, X. Lu, Y. Cui, Z. Zhang. [Determination of 39 polychlorinated biphenyls in indoor dust using ultrasonic extraction and gas chromatography-tandem mass spectrometry]. Sepu / Chinese Journal of Chromatography. 2014. 32:74-80 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2539595	✓						No		Not in English	Evaluation and Review	NA
3350460	RefID 3350460 S. D. Coelho, A. C. Sousa, T. Isobe, J. W. Kim, T. Kunisue, A. J. Nogueira, S. Tanabe. Brominated, chlorinated and phosphate organic contaminants in house dust from Portugal. Science of the Total Environment. 2016. 569-570:442-449 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3350460	✓						No		Limited number of congeners analyzed	Applicability and Utility	Collected 28 house dust samples in 2 Portuguese cities in 2010 and 2011; analyzed for 6 non-dioxin-like PCBs (28, 52, 101, 138, 153, 180) and 12 dioxin-like PCBs; sum of congeners ranged from 0.00018 to 0.061 ug/g (mean = 0.013 µg/g); predominant congeners were 138, 101, 153, and 180, reflecting predominant use of Aroclor 1254 and 1260.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
3351123	RefID 3351123 S. Harrad, M. A. Abdallah, T. Oluseyi. Polybrominated diphenyl ethers and polychlorinated biphenyls in dust from cars, homes, and offices in Lagos, Nigeria. Chemosphere. 2016. 146:346-353 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3351123	✓						No		Limited number of congeners analyzed	Applicability and Utility	Collected dust samples from 16 cars, 18 offices, and 12 houses in Nigeria in 2014; analyzed for 6 indicator PCBs (28, 52, 101, 138, 153, 180); concentrations of individual congeners ranged from 0.00008 to 0.0091 µg/g in cars, 0.00054 to 0.034 µg/g in offices, and 0.00022 to 0.024 µg/g in homes; average concentrations of individual congeners ranged from 0.0013 to 0.0025 µg/g in cars, 0.0046 to 0.014 µg/g in offices, and 0.0037 to 0.010 µg/g in homes; total PCBs not provided.
5016984	RefID 5016984 K. Arnold, J. P. Teixeira, A. Mendes, J. Madureira, S. Costa, A. Salamova. A pilot study on semivolatile organic compounds in senior care facilities: Implications for older adult exposures. Environmental Pollution. 2018. 240:908-915 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5016984	✓					Yes			Data for U.S. background location; multiple congeners measured	--	Dust samples collected in 11 senior living facilities in urban Portugal (n=28) in 2013, and in 3 facilities in rural Indiana, US (n=14) in 2015; analyzed for 82 PCB congeners; geometric mean ± standard error total PCB concentrations were 0.092 ± 0.05 µg/g (range = 0.024 to 0.750 µg/g) in the US, and 0.098 ± 0.038 µg/g (range = 0.0025 to 0.690 µg/g) in Portugal; major contributors were penta/hexa and di/tri PCB congeners; concentrations were highest in living rooms, followed by bedrooms, and corridors.
198235	RefID 198235 R. A. Rudel, L. M. Seryak, J. G. Brody. PCB-containing wood floor finish is a likely source of elevated PCBs in residents' blood, household air and dust: A case study of exposure. Environmental Health: A Global Access Science Source. 2008. 7:2 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198235	✓		✓				No		Limited number of congeners analyzed; not background	Applicability and Utility	Case study; elevated PCBs in dust and air in 2 homes linked to use of PCB-containing floor finish; 3 congeners measured.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198194	RefID 198194 S. Harrad, J. Ren, S. Hazrati, M. Robson. Chiral signatures of PCB#s 95 and 149 in indoor air, grass, duplicate diets and human faeces. Chemosphere. 2006. 63:1368-1376 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198194			✓	✓			No		Limited number of congeners analyzed	Applicability and Utility	Only 2 congeners; chiral signatures; West Midlands, UK.
2163234	RefID 2163234 K. Gedik, I. Imamoglu. An Assessment of the Spatial Distribution of Polychlorinated Biphenyl Contamination in Turkey. CLEAN - Soil, Air, Water. 2010. 38:117-128 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2163234		✓	✓	✓			No		No new data on PCBs in soil, indoor air, or outdoor air	Applicability and Utility	Summarizes information on PCBs in Turkey based on a review of the literature.
198165	RefID 198165 S. Batterman, S. Chernyak, Y. Gouden, J. Hayes, T. Robins, S. Chetty. PCBs in air, soil and milk in industrialized and urban areas of KwaZulu-Natal, South Africa. Environmental Pollution. 2009. 157:654-663 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198165		✓		✓				Supplemental	Non-US data, but multiple congeners measured	--	Characterized PCB concentrations of 82 congeners in outdoor air at 3 locations (urban, industrial, and residential) in South Africa; mean total PCB concentration = 0.128 ± 0.047 ng/m^3 (maximum = 0.233 ng/m^3); predominant congeners were 33, 118, 138, and 105; soil concentrations at 2 residential and 1 agricultural site were 0.110 ± 0.116 µg/g in surface soil and 0.019 ± 0.033 µg/g in shallow soil; most prevalent congeners were 41/71, 153/132, and 138/163.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198236	RefID 198236 G. Salihoglu, Y. Tasdemir. Prediction of the PCB pollution in the soils of Bursa, an industrial city in Turkey. Journal of Hazardous Materials. 2009. 164:1523-1531 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198236		✓		✓			No for soil	Supplemental for air	Non-US data, but multiple congeners measured in air; predicted concentrations in soil	Applicability and Utility	Concentrations of the sum of 41 PCB congeners were predicted in Turkish soil based on equilibrium partitioning from air measurements from 4 sites that ranged from 0.035 to 1.112 ng/m^3; predicted soil concentrations = 25 to 690 pg/g (0.000025 to 0.00069 µg/g); urban, suburban, residential, industrial sites sampled in 2004/2005.
198253	RefID 198253 Z. Zhang, L. Liu, Y. F. Li, D. Wang, H. Jia, T. Harner, E. Sverko, X. Wan, D. Xu, N. Ren, J. Ma, K. Pozo. Analysis of polychlorinated biphenyls in concurrently sampled Chinese air and surface soil. Environmental Science and Technology. 2008. 42:6514-6518 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198253		✓		✓				Supplemental	Non-US data, but multiple congeners measured	--	Air samples collected at 97 sites and soil samples collected at 51 sites in China in 2005; analyzed for 60 congeners; mean air concentration for all 97 sites = 0.25 ng/m^3 (range = 0.029 at a background site to 1.05 ng/m^3 at a rural site; urban sites = 0.35 ± 0.218 ng/m^3; rural = 0.23 ± 0.18 ng/m^3; background = 0.077 ± 0.05 ng/m^3; mean soil concentration = 0.000488 µg/g; range = 0.000138 to 0.00184 µg/g.
2149390	RefID 2149390 D. Yolsal, G. Salihoglu, Y. Tasdemir. Air-soil exchange of PCBs: levels and temporal variations at two sites in Turkey. Environmental Science and Pollution Research. 2014. 21:3920-3935 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149390		✓		✓				Supplemental	Non-US data, but multiple congeners measured	--	51 air and soil samples were collected from 2 areas of Turkey (urban and coastal) and analyzed for 82 PCB congeners; total PCBs in air ranged from 0.1 to 0.9 ng/m^3 (mean = 0.36 ± 0.21) in urban areas and 0.075 to 1.025 ng/m^3 (mean = 0.465 ± 0.285) in coastal areas; total PCBs in soil ranged from 0.000105 to 0.00706 µg/g dw (mean = 0.00201 ± 0.001735) in urban areas (n=26), and 0.00011 to 0.00232 µg/g dw (mean = 0.000535 ± 0.00051) in coastal areas (n=25).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2150581	RefID 2150581 G. Aliyeva, R. Kurkova, I. Hovorkova, J. Klánová, C. Halsall. Organochlorine pesticides and polychlorinated biphenyls in air and soil across Azerbaijan. Environmental Science and Pollution Research. 2012. 19:1953-1962 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150581		✓		✓			No		Limited number of congeners analyzed	Applicability and Utility	Air and surface soil samples collected from 13 urban and rural locations in Azerbaijan; analyzed for 7 PCB congeners; mean sum of 7 PCBs in air = 0.046 ng/m^3; PCB concentrations were <LOD for most rural/background sites, but were 0.209 and 0.071 ng/g dw (0.000209 and 0.000071 µg/g) for 2 urban sites.
2150943	RefID 2150943 X. Wang, X. Lou, G. Han, H. Shen, G. Ding. [Pollution characteristics of PCBs in electronic waste dismantling areas of Zhejiang province]. Wei Sheng Yan Jiu [Journal of Hygiene Research]. 2011. 40:583-6, 590 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150943		✓		✓			No		Full text not available	Evaluation and Review	NA
2153160	RefID 2153160 Y. F. Li, T. Harner, L. Liu, Z. Zhang, N. Q. Ren, H. Jia, J. Ma, E. Sverko. Polychlorinated biphenyls in global air and surface soil: distributions, air-soil exchange, and fractionation effect. Environmental Science and Technology. 2010. 44:2784-2790 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153160		✓		✓			No		No new data on PCBs in soil	Applicability and Utility	Provides background concentrations for various geographic regions based on literature review (ng/m^3): 0.07 (0.0051-0.17) for Europe, 0.079 (0.049-0.12) for North America, 0.066 (0.018-0.110) for South America, 0.27 (0.009-0.67) for Central America, 0.059 (0.017-0.15) for Asia, and 0.015 (0.013-0.017) for Australia; provides average soil concentrations (ug/g dry weight) for PCBs at background sites: 0.0075 for Europe, 0.0043 (0.00011-0.025) for North America, 0.0014 for South America, 0.0058 for Asia, 0.00390 for Africa, and 0.0028 for Australia.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2155065	RefID 2155065 S. Fu, H. X. Cheng, Y. H. Liu, Z. Z. Yang, X. B. Xu. Spatial character of polychlorinated biphenyls from soil and respirable particulate matter in Taiyuan, China. Chemosphere. 2009. 74:1477-1484 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2155065		✓		✓			No for air	Supplemental for soil	Non-US data, but multiple congeners measured for soil; particulate matter only for air	Applicability and Utility for air	Collected 15 soil samples and 34 respirable particulate matter samples (PM2.5 and PM10) from an urban area of Taiyuan, China in 2006; analyzed for 144 PCB congeners; total PCBs in soil ranged from 0.000051 to 0.0047 µg/g dw (median = 0.00064 µg/g); total PCBs in PM2.5 ranged from 0.027 to 0.14 ng/m^3 (median = 0.049 ng/m^3); total PCBs in PM10 ranged from 0.016 to 0.19 ng/m^3 (median = 0.049 ng/m^3).
2533919	RefID 2533919 X. Liu, J. Li, Q. Zheng, H. Bing, R. Zhang, Y. Wang, C. Luo, X. Liu, Y. Wu, S. Pan, G. Zhang. Forest Filter Effect versus Cold Trapping Effect on the Altitudinal Distribution of PCBs: A Case Study of Mt. Gongga, Eastern Tibetan Plateau. Environmental Science and Technology. 2014. 48:14377-14385 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2533919		✓		✓			No		Remote location	Applicability and Utility	Soil samples collected from the organic horizon on 9 sites on Mt Gongga, Eastern Tibetan plateau in 2012; analyzed for 24 PCB congeners; passive air samples collected at the same sites; concentrations of 24 measured PCBs ranged from 0.000041 to 0.00051 µg/g dw (mean = 0.00026 µg/g dw); air concentrations ranged from 0.033 to 0.06 ng/m^3 (mean = 0.047 ng/m^3).
2929235	RefID 2929235 E. A. Mamontova, E. N. Tarasova, A. A. Mamontov. Persistent organic pollutants in the natural environments of the city of Bratsk (Irkutsk Oblast): Levels and risk assessment. Eurasian Soil Science. 2014. 47:1144-1151 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2929235		✓		✓				Supplemental	Non-US data, but multiple congeners measured	--	Soil was sampled in the city of Bratsk, Russia (location of a hydro power plant) in 2009 in residential, recreational, and industrial zones; 21 sampling sites; analyzed for 37 PCB congeners; mean total PCBs = 0.012 µg/g dw; range = 0.0012-0.050 µg/g; in most soil samples, PCBs 101/90, 110, 118, 138, and 153 make the largest contributions to their total content; total PCBs in air ranged from 2.69 to 13.48 ng/m^3 (see Table 3 of paper) with tetra- congeners making the biggest contribution to total.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
3351069	RefID 3351069 V. D. Dang, D. M. Walters, C. M. Lee. Assessing atmospheric concentration of polychlorinated biphenyls (PCBs) by evergreen Rhododendron maximum next to a contaminated stream. Environmental Toxicology and Chemistry. 2016. 35:2192-2198 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3351069		✓		✓			No		Contaminated area	Applicability and Utility	Atmospheric PCBs were monitored using leaves from broadleaf evergreens (Rhododendron) growing next to a contaminated stream that is part of a Superfund site in South Carolina in fall 2010, winter 2011, and spring 2011; measured 47 PCB congeners; 3 composite samples per time frame; mean concentrations of sum of PCBs were 3.99 ng/m^3 (range = 3.42 to 4.75 ng/m^3) in fall 2010, 2.85 ng/m^3 (range = 2.79 to 2.98 ng/m^3) in winter 2011, and 0.931 ng/m^3 (range = 0.645 to 1.11 ng/m^3) in spring 2011; tetra PCBs dominated; PCBs were below detection limits in leaf samples collected at an upstream reference site; PCBs were detected in soil at a mean concentration of 0.4819 ± 0.1017 µg/g.
3986271	RefID 3986271 E. A. Mamontova, A. A. Mamontov, E. N. Tarasova. Ecological and Hygienic Assessment of the Consequences of the Pollution with Persistent Organic Compounds of an Industrial Town (by the Example of Usol'e-Sibirskoe): I. Atmospheric Air, Snow, and Soil. Russian Journal of General Chemistry. 2016. 86:2987-2996 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3986271		✓		✓				Supplemental	Non-US data, but multiple congeners measured	--	Air and soil collected from a Russian town with a long history of chlorine-based industry; air samples collected at 3 stations in 2010-2011; soil samples collected at 47 sites in residential, recreational, and industrial zones in 2004-2014; "analytes detected in all samples included 18-37 individual PCB congeners and their groups"; concentration of total PCBs in air = 0.228 ng/m^3 (0.015-0.745 ng/m^3); concentration of total PCBs in soil in the city and its suburbs = 0.0475 µg/g (0.00087-0.518 µg/g); total PCBs in soil including residential and recreational areas = 0.0768 (range = 0.00725-0.46 µg/g); sum of 6 indicator PCBs in air = 0.079 ng/m^3 (0.0055-0.304 ng/m^3); sum of 6 indicator PCBs in soil = 0.0184 µg/g (0.00033-0.234 µg/g).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
1242565	RefID 1242565 D. Zimmer, K. Kiersch, G. Jandl, R. Meissner, N. Kolomiytsev, P. Leinweber. Status Quo of Soil Contamination with Inorganic and Organic Pollutants of the River Oka Floodplains (Russia). Water, Air, and Soil Pollution. 2010. 211:299-312 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1242565		✓					No		Limited number of congeners analyzed	Applicability and Utility	Levels of 8 individual PCB congeners in floodplain soils in Russia ranged from <0.0001 to 0.0087 µg/g.
1372081	RefID 1372081 . Krauss, M. Corrective Action Decision Document/Closure Report for Corrective Action Unit 561: Waste Disposal Areas Nevada National Security Site, Nevada. #journal#. 2011. GRA and I:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1372081		✓					No		Not background	Applicability and Utility	Report on corrective action at a contaminated site; PCB contamination removed.
1927642	RefID 1927642 M. Ilyas, A. Sudaryanto, I. E. Setiawan, A. S. Riyadi, T. Isobe, S. Ogawa, S. Takahashi, S. Tanabe. Characterization of polychlorinated biphenyls and brominated flame retardants in surface soils from Surabaya, Indonesia. Chemosphere. 2011. 83:783-791 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1927642		✓						Supplemental	Non-US data, but multiple congeners measured	--	Analyzed 23 soil samples collected in 2008 from 5 types of areas (industrial roads, urban roads, municipal dump sites, rural roads, and agricultural areas) in Indonesia for 62 congeners; the sum of PCBs ranged from non-detect to 0.0096 µg/g (median 0.0012 µg/g).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
1928018	RefID 1928018 M. S. Prudente, G. Malarvannan, S. Tanabe. Persistent Toxic Substances in the Philippine Environment. #journal#. 2007. 7:559-585 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1928018		✓					No		No new data on PCBs in soil	Applicability and Utility	Review of the literature on uses, sources, environmental levels, potential exposures, and management of pollutants in the Philippines; cites a 1998 study by Meijer et al., 2003 in which PCBs concentrations in soil were reported as 0.0059 µg/g dw.
198171	RefID 198171 A. Cachada, L. V. Lopes, A. S. Hursthouse, M. Biasioli, H. Grčman, E. Otabbong, C. M. Davidson, A. C. Duarte. The variability of polychlorinated biphenyls levels in urban soils from five European cities. Environmental Pollution. 2009. 157:511-518 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198171		✓					No		Limited number of congeners analyzed	Applicability and Utility	20 surface soils collected from ornamental gardens, parks, roadsides, riverbanks, playground, school, agricultural and forest area in 5 European cities; analyzed for 19 congeners; median concentrations of sum of PCBs ranged from 0.0057 to 0.022 µg/g in the 5 cities (overall range of concentrations = 0.00062 to 0.172 µg/g); congener profiles resembled Aroclor 1254 and 1260.
198205	RefID 198205 M. Jartun, R. T. Ottesen, T. Volden, Q. Lundkvist. Local sources of polychlorinated biphenyls (PCB) in Russian and Norwegian settlements on Spitsbergen Island, Norway. Journal of Toxicology and Environmental Health, Part A: Current Issues. 2009. 72:284-294 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198205		✓					No		Limited number of congeners analyzed	Applicability and Utility	83 surface soil samples collected from 3 coal mining settlements in Arctic areas (Barentsburg-Russian, Pyramiden-Russian, and Longyearbyen-Norwegian; analyzed for 7 PCB congeners (28, 52, 101, 118, 138, 153, 180); concentrations of the sum of PCBs ranged from 0.052 to 28.7 µg/g (median = 0.268 µg/g) at Barentsburg (n=22), <0.004 to 13.9 µg/g (median = 0.172 µg/g) at Pyramiden (n=31), and <0.004 to 0.131 µg/g (median = <0.004 µg/g) at Longyearbyen (n=30).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198238	RefID 198238 M. Schuhmacher, M. Nadal, J. L. Domingo. Levels of PCDD/Fs, PCBs, and PCNs in soils and vegetation in an area with chemical and petrochemical industries. Environmental Science and Technology. 2004. 38:1960-1969 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198238		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil samples collected at contaminated areas and background site in Spain; sum of 7 PCB congeners at unpolluted site = 657 ng/kg (0.000657 µg/g).
198239	RefID 198239 B. Skrbic, J. Cvejanov, N. Durisic-Mladenovic. Organochlorine pesticides and polychlorinated biphenyls in surface soils of Novi Sad and bank sediment of the Danube River. Journal of Environmental Science and Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes. 2007. 42:311-319 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198239		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil samples collected from 5 areas (park-school-backyard-downtown, park-school-backyard-outskirts, market garden, industrial area, roadside arable fields) in a city in Serbia in 2002; analyzed for 6 indicator PCBs (28, 52, 101, 138, 153, 180); mean concentrations for the sum of 6 congeners were 0.00032 µg/g dw in park-school-backyard-downtown, 0.00022 µg/g in market garden, and <0.00004 µg/g in all other areas.
198247	RefID 198247 D. G. Wang, M. Yang, H. L. Jia, L. Zhou, Y. F. Li. Levels, distributions and profiles of polychlorinated biphenyls in surface soils of Dalian, China. Chemosphere. 2008. 73:38-42 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198247		✓						Supplemental	Non-US data, but multiple congeners measured	--	Surface soil samples collected from 14 sites in Dalian, China (n=7 urban business/residence, n=4 industrial, n=2 garden, n=1 rural) in 2007; analyzed for 84 PCB congeners; mean concentration of sum of PCBs over all sites = 0.0028 µg/g dw (range = 0.001337 to 0.00477 µg/g).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198252	RefID 198252 H. B. Zhang, Y. M. Luo, M. H. Wong, Q. G. Zhao, G. L. Zhang. Concentrations and possible sources of polychlorinated biphenyls in the soils of Hong Kong. Geoderma. 2007. 138:244-251 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198252		✓					No		Limited number of congeners analyzed	Applicability and Utility	66 surface soils samples collected in urban parks, country parks, and rural sites in Hong Kong in 2000; analyzed for 7 indicator PCB congeners (28, 52, 101, 118, 138, 153, 180); detectable concentrations of the sum of 7 congeners ranged from 0.00007 to 0.00987 µg/g dw (median = 0.00053, mean = 0.00245 ± 0.00336 µg/g) over all sites, with higher concentrations in the urban site than in the countryside; dominated by lower chlorinated congeners; source mainly associated with Aroclors 1242 and 1248.
198653	RefID 198653 J. Gao, Y. Luo, Q. Li, H. Zhang, L. Wu, J. Song, W. Qian, P. Christie, S. Chen. Distribution patterns of polychlorinated biphenyls in soils collected from Zhejiang province, east China. Environmental Geochemistry and Health. 2006. 28:79-87 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198653		✓						Supplemental	Non-US data, but multiple congeners measured	--	Measured PCBs in 131 soil samples (rural: paddy, upland, forest, wasteland) in China; concentrations ranged from 0.0075 to 0.263 µg/g dw (mean = 0.0454 ± 0.0406 µg/g); total PCB concentrations appear to reflect measurements of Aroclors 1221, 1242, and 1254 based on the analytical standards used.
2149571	RefID 2149571 B. Aichner, B. Bussian, P. Lehnik-Habrink, S. Hein. Levels and spatial distribution of persistent organic pollutants in the environment: a case study of german forest soils. Environmental Science and Technology. 2013. 47:12703-12714 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149571		✓					No		Limited number of congeners analyzed	Applicability and Utility	6 PCB congeners were evaluated in 447 forest soil samples in Germany; the concentrations of the sum of PCBs ranged from <LOD to 0.106 µg/g dw; mean = 0.018 µg/g; median = 0.014 µg/g.

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							Yes	No	Other			
2E+06	RefID 2149589 Z. L. Zhang, C. Leith, S. M. Rhind, C. Kerr, M. Osprey, C. Kyle, M. Coull, C. Thomson, G. Green, L. Maderova, C. Mckenzie. Long term temporal and spatial changes in the distribution of polychlorinated biphenyls and polybrominated diphenyl ethers in Scottish soils. Science of the Total Environment. 2014. 468-469:158-164 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149589		✓					No		Limited number of congeners analyzed	Applicability and Utility	Analyzed soil samples from Scotland from 3 time periods (n=30 each) for the sum of 7 PCB congeners; concentrations ranged from 0.00491 to 0.0577 (mean = 0.0224 ± 0.0143) µg/g for 1990, 0.00023 to 0.0214 (mean = 0.00494 ± 0.0397) µg/g for 1999, and 0.00077 to 0.0195 (mean = 0.00455 ± 0.00408) µg/g for 2007-2009.
2149606	RefID 2149606 E. A. Mamontova, A. A. Mamontov, E. N. Tarasova, M. I. Kuzmin, D. Ganchimeg, M. Y. Khomutova, O. Gombosuren, E. Ganjuurjav. Polychlorinated biphenyls in surface soil in urban and background areas of Mongolia. Environmental Pollution. 2013. 182:424-429 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149606		✓						Supplemental	Non-US data, but multiple congeners measured	--	Surface soils collected from 61 urban, rural, and background locations in Mongolia in 2010/2011; analyzed for 37 PCB congeners; average sum of congeners in soil was 0.0074 µg/g dw (range = 0.00053 to 0.114 µg/g; the highest concentrations were observed in 3 industrial towns and their suburbs and 1 rural site; soil from highly polluted sites had congener patterns similar to Aroclor 1254.
2149634	RefID 2149634 G. Salihoglu, Y. Tasdemir, N. K. Salihoglu, H. S. Baskaya, E. Aksoy. Seasonal variations of polychlorinated biphenyls in surface soils and air-soil exchange in bursa, Turkey. Archives of Environmental Contamination and Toxicology. 2013. 65:619-634 https://heronet.epa.gov/heronet/		✓						Supplemental	Non-US data, but multiple congeners measured	--	Collected 43 urban, rural, and industrial soil samples over the course of a year in Turkey; analyzed for 83 PCB congeners; mean concentrations of the total PCBs were 0.001275 ± 0.00112, 0.004075 ± 0.002740, 0.002185 ± 0.00201, and 0.00115 ± 0.00154 µg/g dw in spring, summer, autumn, and winter seasons, respectively.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	index.cfm/reference/download/reference_id/2149634											
2149695	RefID 2149695 S. M. Rhind, C. E. Kyle, C. Kerr, M. Osprey, Z. L. Zhang, E. I. Duff, A. Lilly, A. Nolan, G. Hudson, W. Towers, J. Bell, M. Coull, C. Mckenzie. Concentrations and geographic distribution of selected organic pollutants in Scottish surface soils. Environmental Pollution. 2013. 182:15-27 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149695		✓					No		Limited number of congeners analyzed	Applicability and Utility	Collected surface soil from different areas of Scotland over a 3 year period; measured 7 PCB congeners in soil; range of sum of PCBs was 0.00004 to 0.0112 µg/g dw; mean = 0.00171 µg/g dw; concentrations varied across areas and soil types.
2149906	RefID 2149906 B. Kumar, V. K. Verma, S. Kumar, C. S. Sharma. Probabilistic health risk assessment of polycyclic aromatic hydrocarbons and polychlorinated biphenyls in urban soils from a tropical city of India. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering. 2013. 48:1253-1263 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149906		✓						Supplemental	Non-US data, but multiple congeners measured	--	Soil samples collected from 13 urban sites in Kurukshetra, India in 2012; analyzed for 28 PCB congeners, including 12 dioxin-like PCBs; total PCBs ranged from 0.00333 to 0.03481 µg/g (mean = 0.01157 µg/g, median = 0.00823 µg/g (see Table 5 of paper).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2150270	RefID 2150270 H. Hou, L. Zhao, J. Zhang, Y. F. Xu, Z. G. Yan, L. P. Bai, F. S. Li. Organochlorine pesticides and polychlorinated biphenyls in soils surrounding the Tanggu Chemical Industrial District of Tianjin, China. Environmental Science and Pollution Research. 2013. 20:3366-3380 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150270		✓					No		Limited number of congeners analyzed	Applicability and Utility	Surface soils collected from 70 sampling sites in an industrial district in China; analyzed for 7 PCBs; range of sum of PCBs was non-detect to 0.373 µg/g; mean = 0.0462 µg/g; dominated by 5 and 6 chlorinated PCBs.
2150571	RefID 2150571 X. P. Wang, J. J. Sheng, P. Gong, Y. G. Xue, T. D. Yao, K. C. Jones. Persistent organic pollutants in the Tibetan surface soil: spatial distribution, air-soil exchange and implications for global cycling. Environmental Pollution. 2012. 170:145-151 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150571		✓					No		Remote location	Applicability and Utility	PCBs measured in 40 background surface soils in Tibetan Plateau (remote sites); range for sum of 15 PCB congeners = 0.000075 to 0.00102 µg/g dw.
2150856	RefID 2150856 A. Martinez, N. R. Erdman, Z. L. Rodenburg, P. M. Eastling, K. C. Hornbuckle. Spatial distribution of chlordanes and PCB congeners in soil in Cedar Rapids, Iowa, USA. Environmental Pollution. 2012. 161:222-228 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150856		✓				Yes			Data for U.S. background location; multiple congeners measured	--	Residential soils (n=64) from Cedar Rapids, Iowa, were collected and analyzed for PCBs; total PCB concentrations (sum of 164 congener peaks) ranged from 0.003 to 1.2 µg/g dw; mean = 0.056 ± 0.160 µg/g dw; median = 0.020 µg/g.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2150858	RefID 2150858 X. Zheng, X. Liu, G. Jiang, Y. Wang, Q. Zhang, Y. Cai, Z. Cong. Distribution of PCBs and PBDEs in soils along the altitudinal gradients of Balang Mountain, the east edge of the Tibetan Plateau. Environmental Pollution. 2012. 161:101-106 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150858		✓					No		Remote location	Applicability and Utility	Soil samples collected from 7 sites on Balang mountain range, Tibet (far from residential sites); analyzed for 25 PCB congeners; range of sum of 25 congeners = 0.000059 to 0.000287 µg/g) mean = 0.000163 µg/g.
2150973	RefID 2150973 K. Mishra, R. C. Sharma, S. Kumar. Contamination levels and spatial distribution of organochlorine pesticides in soils from India. Ecotoxicology and Environmental Safety. 2012. 76:215-225 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150973		✓					No		No new data on PCBs in soil	Applicability and Utility	Not PCBs; pesticide data only.
2151038	RefID 2151038 Z. Li, S. Kong, L. Chen, Z. Bai, Y. Ji, J. Liu, B. Lu, B. Han, Q. Wang. Concentrations, spatial distributions and congener profiles of polychlorinated biphenyls in soils from a coastal city--Tianjin, China. Chemosphere. 2011. 85:494-501 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151038		✓						Supplemental	Non-US data, but multiple congeners measured	--	Analyzed 84 PCB congeners in 82 urban, suburban, and rural surface soil samples from Tianjin, China; mean sum of 84 PCBs = 0.004 µg/g dw; range = 0.00036 to 0.01688 µg/g dw; median = 0.00293 µg/g dw.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2151076	RefID 2151076 J. K. Schuster, R. Gioia, C. Moeckel, T. Agarwal, T. D. Bucheli, K. Breivik, E. Steinnes, K. C. Jones. Has the burden and distribution of PCBs and PBDEs changed in European background soils between 1998 and 2008? Implications for sources and processes. Environmental Science and Technology. 2011. 45:7291-7297 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151076		✓						Supplemental	Non-US data, but multiple congeners measured	--	Compared concentrations of PCBs in background soil samples collected in 1998 (n=48) to samples collected in 2008 (n=70) from the same areas in the UK and Norway; sum of 31 PCB congeners measured; mean total PCB concentration was 0.00919 ± 0.0089 µg/g soil organic matter in 1998 and 0.00645 ± 0.00545 µg/g in 2008 (range = 0.00021 to 0.0271 µg/g).
2151082	RefID 2151082 Y. Wang, C. L. Luo, J. Li, H. Yin, X. D. Li, G. Zhang. Characterization and risk assessment of polychlorinated biphenyls in soils and vegetations near an electronic waste recycling site, South China. Chemosphere. 2011. 85:344-350 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151082		✓					No		Contaminated area	Applicability and Utility	Sum of 32 PCB congeners in surface soils from a town in China with an e-waste recycling plant; samples collected from a burning site (n=6), paddy field (n=14), vegetable field (n=10), and deserted soil (n=4); mean concentrations were 2.1 ug/g dw for the burning site, 0.066 µµg/g for the vegetable field, 0.017 µg/g for the paddy field and 0.011 µg/g for deserted soil; overall range for all sites = 0.0074 to 4.0 µg/g.
2151152	RefID 2151152 C. Turgut, L. Atatanir, B. Mazmanci, M. A. Mazmanci, B. Henkelmann, K. W. Schramm. The occurrence and environmental effect of persistent organic pollutants (POPs) in Taurus Mountains soils. Environmental Science and Pollution Research. 2012. 19:325-334		✓					No		Limited number of congeners analyzed	Applicability and Utility	Co-planar PCBs measured in soil from the Taurus mountains in Turkey; range = 0.00008 to 0.000288 µg/g.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151152											
2151693	RefID 2151693 Y. Jiang, X. Wang, K. Zhu, M. Wu, G. Sheng, J. Fu. Polychlorinated biphenyls contamination in urban soil of Shanghai: level, compositional profiles and source identification. Chemosphere. 2011. 83:767-773 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151693		✓						Supplemental	Non-US data, but multiple congeners measured	--	Collected 55 surface soil samples from 5 types of urban areas (roadsides, greenbelts, parks, residential, commercial) of China; analyzed for 144 congeners; 74 detected; sum of 74 congeners ranged from 0.000232 to 0.011 µg/g; mean = 0.003057 µg/g.
2152146	RefID 2152146 R. Costilla-Salazar, A. Trejo-Acevedo, D. Rocha-Amador, O. Gaspar-Ramírez, F. Díaz-Barriga, I. N. Pérez-Maldonado. Assessment of polychlorinated biphenyls and mercury levels in soil and biological samples from San Felipe, Nuevo Mercurio, Zacatecas, Mexico. Bulletin of Environmental Contamination and Toxicology. 2011. 86:212-216 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152146		✓					No		Contaminated area	Applicability and Utility	Determined 14 PCB congeners in 55 soil samples collected from 4 zones at a mining site in Mexico where PCBs and other materials had also been stored; overall range = non-detect to 0.19 µg/g; mean concentrations in the 4 zones ranged from 0.0142 to 0.0355 µg/g.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2152242	RefID 2152242 S. Wu, X. Xia, L. Yang, H. Liu. Distribution, source and risk assessment of polychlorinated biphenyls (PCBs) in urban soils of Beijing, China. Chemosphere. 2011. 82:732-738 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152242		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil (n=127) collected from 6 urban land types in Beijing, China; analyzed for 18 congeners; total PCB concentrations ranged from <MDL to 0.037 µg/g; mean = 0.0117 µg/g; median = 0.0133 µg/g; Aroclor 1016, 1242, 1248 were important sources.
2152319	RefID 2152319 G. Salihoglu, N. K. Salihoglu, E. Aksoy, Y. Tasdemir. Spatial and temporal distribution of polychlorinated biphenyl (PCB) concentrations in soils of an industrialized city in Turkey. Journal of Environmental Management. 2011. 92:724-732 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152319		✓						Supplemental	Non-US data, but multiple congeners measured	--	Surface soil samples collected from 43 urban sites (ranging from relatively remote to heavy industrial) in Bursa, Turkey over 4 seasons; analyzed for 83 PCB congeners; mean total PCBs = 0.002122 µg/g dw (range = 0.000208 to 0.005462 µg/g dw); dominated by low chlorinated homologue groups; highest concentrations in free industrial zone and large steel foundry.
2152436	RefID 2152436 J. M. Armitage, M. Hanson, J. Axelman, I. Cousins. Levels and vertical distribution of PCBs in agricultural and natural soils from Sweden. Science of the Total Environment. 2006. 371:344-352 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152436		✓					No		Limited number of congeners analyzed	Applicability and Utility	Six soil cores were collected to evaluate the vertical distribution of PCBs: 1 at an agricultural site and 5 at non-agricultural sites in Sweden; analyzed for 13 PCB congeners; at the non-agricultural site PCBs declined with depth (range of sum of PCBs in the surface layer = 0.00055 to 0.055 µg/g dw, median = 0.0044 µg/g); no gradient was observed at agricultural site (sum of PCBs in the surface layer = 0.0016 µg/g dw); penta-, hexa-, and hepta PCBs dominated.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2153238	RefID 2153238 K. Kiersch, G. Jandl, R. Meissner, P. Leinweber. Small scale variability of chlorinated POPs in the river Elbe floodplain soils (Germany). Chemosphere. 2010. 79:745-753 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153238		✓					No		Limited number of congeners analyzed	Applicability and Utility	Sampled soil at 8 floodplain experimental plots at 2 depths (0-10 cm and 10-20 cm) in Germany and analyzed them for 6 PCB congeners (28, 52, 101, 138, 153, 180); sum of PCBs ranged from 0.045 to 0.064 µg/g at 0-10 cm depth and 0.019 to 0.047 µg/g at 10-20 cm depth.
2153572	RefID 2153572 H. Wang, Q. An, Y. H. Dong, D. C. Li, B. Velde. Contamination and congener profiles of polychlorinated biphenyls from different agricultural top soils in a county of the Tailake Region, China. Journal of Hazardous Materials. 2010. 176:1027-1031 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153572		✓					No		Limited number of congeners analyzed	Applicability and Utility	132 topsoil samples from agricultural land were collected from Tailake Region, China and analyzed for 18 PCB congeners in 2004 and 2006; mean concentration of the sum of PCBs was 0.00107 ± 0.001034 µg/g (range = 0.000016 to 0.00405 µg/g); non-detects assumed to be zero in calculating mean.
2154193	RefID 2154193 P. Wang, Q. Zhang, Y. Wang, T. Wang, X. Li, Y. Li, L. Ding, G. Jiang. Altitude dependence of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) in surface soil from Tibetan Plateau, China. Chemosphere. 2009. 76:1498-1504 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2154193		✓					No		Remote location	Applicability and Utility	Soil samples collected from 15 sites on the Tibetan Plateau in 2005; analyzed for 25 PCB congeners; sum of PCBs ranged from = 0.0000471 to 0.0004426 µg/g dw (mean = 0.0001856 µg/g); low level congeners (mono, di, tri, tetra) accounted for more than 90% of the total PCBs.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2154394	RefID 2154394 I. Holoubek, L. Dusek, M. Sánka, J. Hofman, P. Cupr, J. Jarkovský, J. Zbíral, J. Klánová. Soil burdens of persistent organic pollutants--their levels, fate and risk. Part I. Variation of concentration ranges according to different soil uses and locations. Environmental Pollution. 2009. 157:3207-3217 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2154394		✓					No		Limited number of congeners analyzed	Applicability and Utility	Analyzed soil samples collected arable land (n=39), grassland (n-22), forest (n=18) soil in the Czech Republic for 13 indicator PCBs; mean total PCB concentrations ranged from 6.86 µg/kg (0.00686 µg/g) for arable soil to 22.76 µg/kg (0.02276 µg/g) for mountain forest soil; range of concentrations for all soil types = 2.01 to 42.1 µg/kg (0.00201 to 0.0421 µg/g).
2154719	RefID 2154719 W. L. Ma, Y. F. Li, D. Z. Sun, H. Qi. Polycyclic aromatic hydrocarbons and polychlorinated biphenyls in topsoils of Harbin, China. Archives of Environmental Contamination and Toxicology. 2009. 57:670-678 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2154719		✓						Supplemental	Non-US data, but multiple congeners measured	--	17 topsoil samples collected in the industrialized city of Harbin, China in 2006 (n=9 urban, 4 suburban, 3 rural, 1 background); analyzed for 44 congeners, including 7 indicator PCBs (28, 52, 101, 188, 138, 153, 180) and 4 dioxin-like PCBs (77,81, 105, 118); total concentrations of the sum of 44 congeners ranged from 0.0003 to 0.00617 µg/g dw (mean = 0.00163 µg/g); total PCBs were highest in urban soil; sum of seven indicator congeners accounted for 25.4% of the total and the sum of 4 dioxin-like PCBs accounted for 4.4% of the total; tri- and tetra- PCBs abundant at all sites.
2E+06	RefID 2154806 F. Borghini, J. O. Grimalt, J. C. Sanchez-Hernandez, R. Bargagli. Organochlorine pollutants in soils and mosses from Victoria Land (Antarctica). Chemosphere. 2005. 58:271-278 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2154806		✓					No		Remote location	Applicability and Utility	Soil samples collected from 4 sites in Antarctica; analyzed for 21 PCB congeners; soil concentrations ranged from 0.36 to 0.59 ng/g dw (0.00036 to 0.00059 µg/g).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2155139	RefID 2155139 C. Moeckel, L. Nizzetto, A. Di Guardo, E. Steinnes, M. Freppaz, G. Filippa, P. Camporini, J. Benner, K. C. Jones. Persistent organic pollutants in boreal and montane soil profiles: distribution, evidence of processes and implications for global cycling. Environmental Science and Technology. 2008. 42:8374-8380 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2155139		✓					No		No new data on PCBs in soil	Applicability and Utility	Describes processes influencing distribution in soil profiles.
2155561	RefID 2155561 S. Fu, H. Cheng, Y. Liu, L. Zhang, Z. Yang, K. Li, X. Xia, X. Xu. Polychlorinated biphenyls residues in the soil in Linfen, China. Bulletin of Environmental Contamination and Toxicology. 2008. 81:594-598 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2155561		✓						Supplemental	Non-US data, but multiple congeners measured	--	Surface soil samples (n=10) collected from 5 urban and 5 industrial sites in Linfen, China in 2006; analyzed for 144 PCB congeners; total PCBs ranged from 0.0002 to 0.0034 µg/g dw (median = 0.001 µg/g) in urban soil and 0.0005 to 0.0148 µg/g dw (median = 0.0024 µg/g) in industrial plant soil; tri-CBs dominated.
2157320	RefID 2157320 N. Ren, M. Que, Y. F. Li, Y. Liu, X. Wan, D. Xu, E. Sverko, J. Ma. Polychlorinated biphenyls in Chinese surface soils. Environmental Science and Technology. 2007. 41:3871-3876 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2157320		✓						Supplemental	Non-US data, but multiple congeners measured	--	Soil samples collected from 52 background (n=4), rural (n=39), and urban (n=9) sites in China in 2005; 51 of 84 targeted PCB congeners were detected; mean total PCB concentration = 0.000515 µg/g dw (range = 0.000138 to 0.00184).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2157729	RefID 2157729 B. Skrbić, N. Durisić-Mladenović. Distribution of chlorinated organic pollutants in a wide variety of soils from Europe and Asia: a multivariate statistical approach. Archives of Environmental Contamination and Toxicology. 2007. 52:466-474 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2157729		✓					No		Limited number of congeners analyzed	Applicability and Utility	Principal component analyses used to interpret data on PCBs in soils from Europe and Asia from the literature for 6 marker PCB congeners; evaluated spacial distribution and regional variability; no new PCB data.
2157823	RefID 2157823 B. Skrbić, N. Durisić-Mladenović. Principal component analysis for soil contamination with organochlorine compounds. Chemosphere. 2007. 68:2144-2152 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2157823		✓					No		No new data on PCBs in soil	Applicability and Utility	Principal component analyses used to investigate the distribution pattern of individual organochlorine compounds in soil samples collected from sites (Canary Island – Spain, China, Germany, India, Romania, Russia, Serbia, Swiss, UK) affected by industrial activities to the more remote areas using data taken from literature; 6 indicator PCBs; no new PCB data.
2158048	RefID 2158048 E. Heywood, J. Wright, C. L. Wienburg, H. I. Black, S. M. Long, D. Osborn, D. J. Spurgeon. Factors influencing the national distribution of polycyclic aromatic hydrocarbons and polychlorinated biphenyls in British soils. Environmental Science and Technology. 2006. 40:7629-7635 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2158048		✓						Supplemental	Non-US data, but multiple congeners measured	--	33 PCB congeners were measured in ~200 rural soil samples (n=15) collected in Great Britain; mean total PCBs = 0.005028 ± 0.008411 µg/g dw (range = 0.000274 to 0.080579 µg/g).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2158705	RefID 2158705 Z. Cui, H. Xu, X. Wang, J. Liu. Spatial Distribution and Enantiomeric Signature of Chiral Polychlorinated Biphenyls in Soils of Jinan, China. Environmental Engineering Science. 2012. 29:758-764 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2158705		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil samples collected from 9 urban and 14 rural sites in east coast of China (Jinan) in 2008; analyzed for 3 chiral PCB congeners (95, 132, 149); concentration of sum of 3 PCBs ranged from 0.000022 to 0.000695 µg/g dw (mean = 0.000163 µg/g).
2158737	RefID 2158737 P. Cupr, T. Bartos, M. Sanka, J. Klanova, O. Mikes, I. Holoubek. Soil burdens of persistent organic pollutants - Their levels, fate and risks Part III. Quantification of the soil burdens and related health risks in the Czech Republic. Science of the Total Environment. 2010. 408:486-494 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2158737		✓					No		No new data on PCBs in soil	Applicability and Utility	Data for 471 soil samples collected in 1996-2006 by 2 monitoring programs were used to model the environmental burden (total in metric tons) of POPs in the top layer of soil and associated risks; no new data; see Holoubek et al., 2009.
2159888	RefID 2159888 W. Wilcke, M. Krauss, G. Safronov, A. D. Fokin, M. Kaupenjohann. Polychlorinated biphenyls (PCBs) in soils of the Moscow region: concentrations and small-scale distribution along an urban-rural transect. Environmental Pollution. 2006. 141:327-335 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2159888		✓						Supplemental	Non-US data, but multiple congeners measured	--	Collected 35 grassland and forest soil samples between 1996 and 2003 from 5 locations in the Moscow region (Russia); all samples analyzed for 17 PCB congeners; subset of 23 analyzed for 33 congeners; sum of 17 PCBs ranged from 0.0031 to 0.042 µg/g and represented 48-61% of the sum of 33 PCBs in the 23 samples (0.0055 to 0.079 µg/g); congeners 138+158, 101, and 52 were most abundant.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2159929	RefID 2159929 A. Dimitrova, A. Spasov, M. Sidjimov, V. Metodiev, M. Tsoneva, G. Garkova. LEVELS OF POLYCHLORINATED BIPHENYLS AND POLYCYCLIC AROMATIC HYDROCARBONS IN SOILS NEARBY METALLURGICAL PLANT KREMIKOVTSY. #journal#. 2009. #volume#:517-522 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2159929		✓					No		Limited number of congeners analyzed	Applicability and Utility	Collected 8 soil samples from a metallurgical site in Bulgaria; analyzed for 6 indicator PCBs (28, 52, 101, 138, 153, 180); concentrations of sum of PCBs ranged from 0.0056 to 0.0182 µg/g (mean = 0.0102 µg/g); congeners 138, 153, and 180 were most abundant.
2161343	RefID 2161343 P. Schmid, E. Gujer, M. Zennegg, T. D. Bucheli, A. Desaules. Correlation of PCDD/F and PCB concentrations in soil samples from the Swiss soil monitoring network (NABO) to specific parameters of the observation sites. Chemosphere. 2005. 58:227-234 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2161343		✓					No		Limited number of congeners analyzed	Applicability and Utility	23 soil samples collected at reference sites in Switzerland in 2002; analyzed for 118 PCB congeners, but data reported for the sum of 7 indicator PCB congeners (28, 52, 101, 118, 138, 153, 180); sum of 7 congener concentrations ranged from 0.0011 to 0.012 µg/g; considered to be in the range of background.
2163561	RefID 2163561 S. N. Meijer, W. A. Ockenden, A. Sweetman, K. Breivik, J. O. Grimalt, K. C. Jones. Global distribution and budget of PCBs and HCB in background surface soils: implications for sources and environmental processes. Environmental Science and Technology.		✓						Supplemental	Non-US data, but multiple congeners measured	--	Surface samples were collected from 191 remote sites worldwide in 1998; analyzed for 29 PCB congeners (tr- through octa-); total PCB concentrations ranged from 0.000026 to 0.0966 µg/g dw (mean = 0.00541 µg/g); lowest and highest levels observed in Greenland and mainland Europe, respectively.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	2003. 37:667-672 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2163561											
2181518	RefID 2181518 C. Prasse, W. Zech, F. Itanna, B. Glaser. Contamination and source assessment of metals, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons in urban soils from Addis Ababa, Ethiopia. Toxicological and Environmental Chemistry. 2012. 94:1954-1979 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2181518		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil and sediment samples collected from several sites (urban land utilization, such as park areas, waste disposal sites, and traffic influenced areas) in Addis Ababa, Ethiopia; analyzed for 11 congeners; total PCB concentrations ranged from 0.0004 µg/g to 0.0185 µg/g (median = 0.0038 µg/g); PCBs 138 and 154 most abundant.
2183958	RefID 2183958 A. Shahbazi, N. Bahramifar, E. Smolders. Elevated Concentrations of Pesticides and PCBs in Soils at the Southern Caspian Sea (Iran) are Related to Land Use. Soil and Sediment Contamination. 2012. 21:160-175 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2183958		✓					No		Limited number of congeners analyzed	Applicability and Utility	45 soil samples collected in 2008 from farms, orchards and forests of Iran; analyzed for 6 PCB congeners (28, 101, 118, 138, 153, 180); total PCB concentrations ranged between 0.0047 and 0.0347 µg/g; PCBs 28, 180, and 138 had the highest mean concentrations; average concentrations of the sum of PCBs ranged from 0.0051 µg/g for forest soils to 0.0287 µg/g for a kiwi orchard.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2186307	RefID 2186307 P. Tremolada, S. Villa, P. Bazzarin, E. Bizzotto, R. Comolli, M. Vighi. POPs in mountain soils from the Alps and Andes: Suggestions for a 'precipitation effect' on altitudinal gradients. Water, Air, and Soil Pollution. 2008. 188:93-109 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2186307		✓						Supplemental	Non-US data, but multiple congeners measured	--	Soil samples collected in the Peruvian Andes (n=10) and Italian Alps (n=19) in 2003/2004; analyzed for 30 congeners (tri- through octa-); sum of tri- through octa-PCBs ranged from <0.00001 to 0.00044 (mean = 0.00008) µg/g dw in Peru and 0.00061 to 0.0089 (mean = 0.0036) µg/g dw in Italy.
2187527	RefID 2187527 P. Wang, Q. Zhang,Thanh Wang, W. Chen, D. Ren, Y. M. Li, G. Jiang. PCBs and PBDEs in environmental samples from King George Island and Ardley Island, Antarctica. RSC Advances. 2012. 2:1350-1355 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2187527		✓					No		Number of congeners not reported; remote site	Clarity and Completeness	PCBs measured in soil (n=8) and sediment (n=1) samples collected at King George Island, Antarctica in 2009-2010; concentrations of total PCBs ranged from 0.0000601 to 0.001436 µg/g dw (mean = 0.00041 µg/g); lower chlorinated congeners dominated; congeners analyzed not reported.
2188472	RefID 2188472 S. Wu, X. Xia, S. Zhang, Q. Liu. Levels and congener patterns of polychlorinated biphenyls (PCBs) in rural soils of Beijing, China. Procedia Environmental Sciences. 2010. 2:1955-1959 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2188472		✓						Supplemental	Non-US data, but multiple congeners measured	--	Measured the levels and congener patterns of PCBs in rural soil in Beijing, China; total PCBs (di- through hepta congeners) ranged from 0.0026 to 0.01956 µg/g (mean = 0.01101 µg/g); lighter congeners (di-, tr-, and tetra-CBs) dominated; non-detects set equal to half detection limit.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2189325	RefID 2189325 H. Zhang, X. Li, Y. Luo, Q. Li. Depth distribution of polychlorinated biphenyls in soils of the Yangtze River Delta region, China. Geoderma. 2011. 160:408-413 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2189325		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil profiles were evaluated in 44 rural soil samples collected in the Yangtze river delta, China in 2003; analyzed for 17 PCB congeners at different soil depths; concentrations of the sum of 17 congeners in the topsoil ranged from 0.00046 to 0.0735 µg/g (mean = 0.0152 µg/g); PCB pattern dominated by penta and tetra CBs.
2189341	RefID 2189341 Zhang Jian-ying,Qiu Li-min,He Jia,Liao Yuan,Luo Yong-ming. Occurrence and congeners specific of polychlorinated biphenyls in agricultural soils from Southern Jiangsu, China. Journal of Environmental Sciences. 2007. 19:338-342 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2189341		✓					No		Limited number of congeners analyzed	Applicability and Utility	198 agricultural surface soil samples collected from Zhangjiagang and Changshu in Southern Jiangsu, China in 2004; analyzed for 13 PCBs (18, 28, 31, 44, 52, 101, 118, 138, 149, 153, 170, 180, 194); total PCBs concentrations ranged from non-detect to 0.03283 ug/g dw (mean = 0.00413 ± 0.00432 µg/g); tetra, penta, and hexa CBs dominated.
2189382	RefID 2189382 Q. Zhang, T. Liang, L. Wang, H. Cao. Determination of polycyclic aromatic hydrocarbons from soil samples using selective pressurized liquid extraction. Analytical Methods. 2012. 4:2441-2446 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2189382		✓					No		No new data on PCBs in soil	Applicability and Utility	Objective of study was to develop methods for the analysis of PAHs (not PCBs) in soils.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2189721	RefID 2189721 A. Zouir, F. A. Esteve-Turrillas, T. Chafik, A. Morales-Rubio, M. De La Guardia. Evaluation of the Soil Contamination of Tangier (Morocco) by the Determination of BTEX, PCBs, and PAHs. Soil and Sediment Contamination. 2009. 18:535-545 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2189721		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil was sampled at 6 urban and industrial sites in Tangier, Morocco; analyzed for 7 PCB congeners (28, 52, 101, 118, 138, 153, 180); "Any of the seven indicator PCBs evaluated in this study were found in the sampled soils at concentrations higher than the LOD values...conclude that the soil in the Tangier area is not contaminated by PCBs."
2920089	RefID 2920089 G. L. Yuan, Y. Sun, J. Li, P. Han, G. H. Wang. Polychlorinated biphenyls in surface soils of the Central Tibetan Plateau: altitudinal and chiral signatures. Environmental Pollution. 2015. 196:134-140 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920089		✓					No		Remote location	Applicability and Utility	44 soil samples were collected in 2010 from the Central Tibetan Plateau; analyzed for 122 PCB congeners; concentrations of the sum of PCBs ranged from 0.00006698 to 0.00015081 µg/g (mean = 0.00010064 µg/g); di-to Hexa-PCBs contributed approximately 90% to the sum of PCBs.
2920107	RefID 2920107 H. Lu, W. Liu. Vertical distributions of organochlorine pesticides and polychlorinated biphenyls in an agricultural soil core from the Guanzhong Basin, China. Environmental Monitoring and Assessment. 2015. 187:4159 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920107		✓					No		Limited number of congeners analyzed	Applicability and Utility	Agricultural soil cores collected in the Guanzhong Province, China in 2013; samples analyzed at 5 cm intervals; analyzed for 7 PCB congeners (28, 52, 101, 118, 152, 138, 180); sum of PCB concentrations ranged from 0.00014 to 0.00344 µg/g (mean = 0.00079 µg/g) with the highest concentration being observed in the 5-10 cm fraction; lower chlorinated congeners were detected more frequently and at higher concentrations than higher chlorinated PCBs; PCBs 28 and 52 dominated.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2920186	RefID 2920186 Q. Zheng, L. Nizzetto, M. D. Mulder, O. Sáňka, G. Lammel, J. Li, H. Bing, X. Liu, Y. Jiang, C. Luo, G. Zhang. Does an analysis of polychlorinated biphenyl (PCB) distribution in mountain soils across China reveal a latitudinal fractionation paradox?. Environmental Pollution. 2014. 195:115-122 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920186		✓						Supplemental	Non-US data, but multiple congeners measured	--	159 forest soil samples collected from 82 locations at 30 mountain sites in China in 2012/2013; analyzed for 29 PCB congeners; sum of PCBs in the organic layer ranged from 0.000057 to 0.00132 µg/g (mean = 0.00051 µg/g).
2920197	RefID 2920197 J. Zhang, M. Pan, N. Gan, Y. Cao, D. Wu. Employment of a novel magnetically multifunctional purifying material for determination of toxic highly chlorinated polychlorinated biphenyls at trace levels in soil samples. Journal of Chromatography A. 2014. 1364:36-44 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920197		✓					No		No new data on PCBs in soil	Applicability and Utility	Developed method to remove matrix interferences when determining trace levels of PCBs in soil; no data on soil concentrations in the environment provided.
2920233	RefID 2920233 J. L. Zhou, E. Siddiqui, H. H. Ngo, W. Guo. Estimation of uncertainty in the sampling and analysis of polychlorinated biphenyls and polycyclic aromatic hydrocarbons from contaminated soil in Brighton, UK. Science of the Total Environment. 2014. 497-498:163-171		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil samples (n=48) collected from a former landfill site in Australia in 2009; analyzed for 14 PCB congeners; total PCB concentration ranged from 0.0017 to 0.0132 µg/g dw; congeners with 6 chlorines dominated.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920233											
2924494	RefID 2924494 I. N. Perez-Maldonado, R. C. Salazar, C. A. Ilizaliturri-Hernandez, G. Espinosa-Reyes, F. J. Perez-Vazquez, J. C. Fernandez-Macias. Assessment of the polychlorinated biphenyls (PCBs) levels in soil samples near an electric capacitor manufacturing industry in Morelos, Mexico. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering. 2014. 49:1244-1250 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2924494		✓						Supplemental	Non-US data, but multiple congeners measured	--	Collected surface soil samples from a contaminated site (electric capacitor manufacturing) and a reference site in Morelos, Mexico in 2009; analyzed for 40 congeners; range of total PCBs at reference site (n=29) was 0.0062 to 0.1867 µg/g (mean = 0.0686 ± 0.0545 µg/g); concentrations of non-dioxin like PCBs higher than dioxin-like; PCB 153 had highest concentration.
2924980	RefID 2924980 H. Lu, W. Liu. Characterization and risk assessment of polychlorinated biphenyls in city park soils of Xi'an, China. Bulletin of Environmental Contamination and Toxicology. 2015. 94:393-398 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2924980		✓					No		Limited number of congeners analyzed	Applicability and Utility	Surface soil samples collected from 8 urban and 15 suburban parks in China in 2014; analyzed for 7 PCBs (28, 52, 105, 118, 152, 138, 180); sum of PCB concentrations ranged from 0.00048 to 0.00404 µg/g (mean = 0.00168 µg/g).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2931741	RefID 2931741 H. Karadeniz, S. Yenisoy-Karakas. Spatial distributions and seasonal variations of organochlorine pesticides in water and soil samples in Bolu, Turkey. Environmental Monitoring and Assessment. 2015. 187:94 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2931741		✓					No		No new data on PCBs in soil	Applicability and Utility	Analyzed soil samples for organochlorine pesticides; not PCBs.
2939978	RefID 2939978 J. A. Padilla-Sanchez, R. Romero-Gonzalez, P. Plaza-Bolanos, A. Garrido Frenich, J. L. Martinez Vidal. Residues and Organic Contaminants in Agricultural Soils in Intensive Agricultural Areas of Spain: A Three Years Survey. CLEAN - Soil, Air, Water. 2015. 43:746-753 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2939978		✓					No		No new data on PCBs in soil	Applicability and Utility	38 topsoil samples collected in greenhouses in Spain in 2009; subset of most contaminated sites selected for further analysis using cluster analyses; analyzed for pesticides, PAHs, and 36 PCB congeners; only compounds detected in >20% of samples further evaluated; PCBs detected only in first sampling and only in 20% of samples so not analyzed further; no PCB concentration data provided.
2944597	RefID 2944597 C. H. Vane, A. W. Kim, D. J. Beriro, M. R. Cave, K. Knights, V. Moss-Hayes, P. C. Nathanail. Polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCB) in urban soils of Greater London, UK. Applied Geochemistry. 2014. 51:303-314 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2944597		✓						Supplemental	Non-US data, but multiple congeners measured	--	76 surface soil samples (urban and semi-urban) collected from East London, United Kingdom in 2009; analyzed for 7 congeners (28, 52, 101, 118, 138, 152, 180) and the tri-hepta homologues; 2 samples removed from analysis for QA reasons; sum of tri- to hepta homologues concentrations ranged from 0.009 to 2.642 µg/g (mean = 0.123 µg/g); sum of 7 congeners ranged from 0.0006 to 0.751 µg/g (mean = 0.0214 µg/g).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
3045476	RefID 3045476 Y. Teng, J. Li, J. Wu, S. Lu, Y. Wang, H. Chen. Environmental distribution and associated human health risk due to trace elements and organic compounds in soil in Jiangxi province, China. Ecotoxicology and Environmental Safety. 2015. 122:406-416 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3045476		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil samples (n=565) were collected from Jiangxi Province, China in 2008; analyzed for 7 PCB congeners (28, 52, 101, 118, 138, 153, 180); concentrations of the sum of congeners ranged from non-detect to 0.093 µg/g (mean = 0.00675 ± 0.0105 µg/g.
3350928	RefID 3350928 A. A. Mamontov, E. N. Tarasova, E. A. Mamontova, E. V. Kerber. The change of polychlorinated biphenyls content in soil of coastal zone of Lake Baikal in 1997-2012. Russian Journal of General Chemistry. 2015. 85:2945-2951 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3350928		✓					No		Results not reported in units needed	Clarity and Completeness	Soil was sampled in coastal Lake Baikal, Russia between 1997 and 2012 to evaluate changes in PCB concentrations over time; 29 congeners analyzed; results were reported in units of ng/cm^2 in Table 3 of paper; based on Figure 3 of the paper, total PCBs in 2012 ranged from about 0 to almost 0.006 ug/g for the 28 sampling sites.
3350971	RefID 3350971 B. Liu, Y. Li, J. Ma, L. Huang, L. Chen. Detection of semi-volatile organic compounds (SVOCs) in surface water, soil, and groundwater in a chemical industrial park in Eastern China. Water, Science and Technology. 2016. 73:1175-1189 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3350971		✓					No		Not background	Applicability and Utility	Investigated SVOCs, including 8 PCB congeners (1, 5, 29, 47, 98, 154, 171, 200), in a chemical industrial park in China; 20 samples of surface water, groundwater, and soil; 6 of the 8 PCBs were detected and PCB 154 was among 10 SVOCs detected at the highest concentrations in soil (0.247 µg/g); data were not provided for total PCBs.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
3351349	RefID 3351349 A. C. Mandigo, D. J. Discenza, A. R. Keimowitz, N. Fitzgerald. Chemical contamination of soils in the New York City area following Hurricane Sandy. Environmental Geochemistry and Health. 2015. 38:1115-1124 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3351349		✓					No		Contaminated area	Applicability and Utility	Collected 63 soil samples at various sites in the metropolitan New York City area including Rockaway Peninsula and the vicinity of Superfund sites Newtown Creek and Gowanus Canal after hurricane Sandy in 2012; analyzed for the sum of 14 PCB congeners (peaks); mean total PCBs were 0.4 ± 0.19 µg/g at Rockaway and 0.7 ± 0.53 µg/g at Newtown; highest value (measured at 2.0 µg/g) was found at a location next to the Gowanus Canal, a site known to contain high levels of PCBs.
3351635	RefID 3351635 Z. Li, P. Zhao, L. Chen,Destech Publicat Inc. PCBs Concentrations, Homolog Profiles and Source in Different Types of Soils from a Coastal City-Tianjin. #journal#. 2015. #volume#:57-60 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3351635		✓					No		Conference proceedings	Evaluation and Review	61 soil samples collected from Tianjin, China; analyzed for 84 PCB congeners; total PCB concentrations for were 0.0128 µg/g at an industrial site, 0.0034 µg/g at an urban site, and 0.0018 µg/g at a background site; tri- and penta- PCBs dominated.
3462441	RefID 3462441 J. Sun, L. Pan, D. C. Tsang, Y. Zhan, W. Liu, X. Wang, L. Zhu, X. Li. Polychlorinated biphenyls in agricultural soils from the Yangtze River Delta of China: Regional contamination characteristics, combined ecological effects and human health risks. Chemosphere. 2016. 163:422-428 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3462441		✓					No		Limited number of congeners analyzed	Applicability and Utility	Measured PCBs in 241 soil samples collected from agricultural fields in Yangtze River Delta, China in 2014; analyzed for 12 dioxin-like PCBs and 6 indicator PCBs (28, 52, 101, 138, 153, 180); total PCBs ranged from <0.0001 to 0.13 µg/g dw (mean = 0.0202 µg/g); sum of 6 indicator PCBs ranged from <0.0001 to 0.119 µg/g (mean = 0.0171 µg/g); major homologue groups were tetra-. tri-, and penta-PCBs; higher PCB concentrations in surface soils (0-30 cm depth) relative to subsurface soils.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
3606223	RefID 3606223 C. Bogdal, N. Niggeler, J. Glüge, P. S. Diefenbacher, D. Wächter, K. Hungerbühler. Temporal trends of chlorinated paraffins and polychlorinated biphenyls in Swiss soils. Environmental Pollution. 2017. 220:891-899 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3606223		✓					No		Limited number of congeners analyzed	Applicability and Utility	Reconstructed temporal trends of PCBs in archived soil samples from 6 sites in Switzerland from 1989-2014; 6 indicator PCBs evaluated (28, 52, 101, 138, 153, 180); concentrations of PCBs in the soil ranged from 0.0005 to 0.010 µg/g; concentrations peaked 1-2 decades ago and were lower in 2014; congener pattern dominated by 153, followed by 138, 101, 52, 180, 28.
3983714	RefID 3983714 M. Pandelova, B. Henkelmann, B. M. Bussian, K. W. Schramm. Results of the second national forest soil inventory in Germany - Interpretation of level and stock profiles for PCDD/F and PCB in terms of vegetation and humus type. Science of the Total Environment. 2017. 610-611:1-9 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3983714		✓					No		Limited number of congeners analyzed	Applicability and Utility	86 humic topsoil samples (O horizon) and 11 top mineral (A horizon) soil samples (0-5 cm and 5-10 cm depth) collected from forested sites in Germany in 2006 and 2008; analyzed for 12 dioxin-like PCBs and 6 indicator PCBs (28, 52, 101, 138, 153, 180); total PCBs in the 86 humic topsoil samples ranged from 0.0016 to 0.125 µg/g dw; total concentrations for the 2 mineral layers range from 0.0000017 to 0.0189 µg/g (0-5 cm) and 0.0000013 to 0.0024 µg/g (5-10 cm).
3984965	RefID 3984965 D. Sosa, I. Hilber, R. Faure, N. Bartolomé, O. Fonseca, A. Keller, P. Schwab, A. Escobar, T. D. Bucheli. Polycyclic aromatic hydrocarbons and polychlorinated biphenyls in soils of Mayabeque, Cuba. Environmental Science and Pollution Research. 2017. 24:12860-12870 https://heronet.epa.gov/heronet/		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil samples collected from 39 locations in Mayabeque, Cuba in 2014; different land uses and soil types included; analyzed for 7 PCB congeners (28, 52, 101, 118, 138, 153, 180); concentrations of the sum of 7 PCBs ranged from 0.0011 to 0.0076 µg/g (median = 0.0028 µg/g); PCBs 153, 138, and 180 dominated; most of the higher end concentrations were from soils collected within 5 km of a thermo-electric plant.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	index.cfm/reference/download/reference_id/3984965											
3985243	RefID 3985243 L. Kim, J. W. Jeon, J. Y. Son, M. K. Park, C. S. Kim, H. J. Jeon, T. H. Nam, K. Kim, B. J. Park, S. D. Choi, S. E. Lee. Monitoring and risk assessment of polychlorinated biphenyls (PCBs) in agricultural soil from two industrialized areas. Environmental Geochemistry and Health. 2017. 39:279-291 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3985243		✓						Supplemental	Non-US data, but multiple congeners measured	--	Soil samples collected from 2 industrialized cities in Korea (Gwangyang, n=10 and Ulsan, n=20); analyzed for 29 PCB congeners, including 7 indicator PCBs (28, 52, 101, 118, 138, 153, 180); total concentrations ranged from 0.000216 to 0.000979 µg/g dw in Gwangyang and 0.0002738 to 0.001824 µg/g in Ulsan; 7 indicator PCBs accounted for 50-80% of the total PCBs; PCB 153 was a major contributor to total PCBs and contamination patterns were indicative of usage of Aroclor 1254.
3985264	RefID 3985264 L. Kim, J. Jeon, Y. Lee, H. J. Jeon, B. J. Park, H. Lee, S. D. Choi, S. E. Lee. Monitoring and risk assessment of polychlorinated biphenyls (PCBs) in agricultural soil collected in the vicinity of an industrialized area. Applied Biological Chemistry. 2016. 59:655-659 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3985264		✓						Supplemental	Non-US data, but multiple congeners measured	--	Soil samples collected from 5 agricultural sites near an industrialized site in Korea; analyzed for 29 congeners; total PCB concentrations ranged from 0.000107 to 0.000223 µg/g dw; penta- and hexa-congeners had the highest concentrations.
3985396	RefID 3985396 J. Gaspéri, S. Ayrault, E. Moreau-Guigon, F. Alliot, P. Labadie, H. Budzinski, M. Blanchard, B. Muresan, E. Caupos, M. Cladière, D. Gateuille, B. Tassin, L. Bordier, M. J. Teil, C. Bourges, A. Desportes, M. Chevreuil, R. Moilleron.		✓					No		Limited number of congeners analyzed	Applicability and Utility	32 soil samples (rural, n=12 and densely urban, n=20) were collected in 2009/2010 across conurbation in greater Paris, France; analyzed for 19 PCB congeners, including 7 indicator PCBs (28, 52, 101 118, 138, 153, 180) and 8 dioxin-like PCBs; concentrations of the sum of 19 PCBs ranged from 0.001 to 0.071 µg/g dw; 7 indicator congeners accounted for 70 to 100% of the total

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	Contamination of soils by metals and organic micropollutants: case study of the Parisian conurbation. Environmental Science and Pollution Research. 2016. 25:23559-23573 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3985396											PCBs in the soils and PCBs 153 and 138 dominated.
3986281	RefID 3986281 S. Maqsood, R. Murugan. Distribution of persistent organic pollutants in aggregate fractions of a temperate forest and semi-rural soil. Journal of Forestry Research. 2017. 28:953-961 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3986281		✓					No		Limited number of congeners analyzed	Applicability and Utility	Soil samples were collected at a forest site (0-2 and 2-5 cm depth) and a semi-rural site (0-4 and 8-12 cm depth) in England; 15 congeners detected, but 6 selected for study based on concentration order (153/132 > 138/110 > 110 > 90/101 > 187 > 52); concentrations of the sum of 6 congeners in the forest soil were 0.000864 ± 0.000196 and 0.000149 ± 0.000032 µg/g dw in the 0-2 cm and 2-5 cm depths, respectively; concentrations of the sum of 6 congeners in the semi-rural soil were 0.000744 ± 0.000083 and 0.000477 ± 0.000004 µg/g dw in the 0-4 cm and 8-12 cm depths, respectively.
5017000	RefID 5017000 W. Meng, P. Wang, R. Yang, H. Sun, J. Matsiko, D. Wang, P. Zuo, Y. Li, Q. Zhang, G. Jiang. Altitudinal dependence of PCBs and PBDEs in soil along the two sides of Mt. Sygera, southeastern Tibetan Plateau. Scientific Reports. 2018. 8:14037 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017000		✓					No		Remote location	Applicability and Utility	Air samples were collected at 15 sites on Mt. Sygeria, Tibet in 2012; analyzed for 19 PCB congeners; average concentrations of the sum of 19 congeners was 0.000144 µg/g dw (range = 0.000033 to 0.000268 µg/g); 7 indicator congeners accounted for more than 95% of total; and di-, tri-, and tetra- congeners accounted for more than 70% of total; PCB 28 dominated.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
5017214	RefID 5017214 . Health Consultation: Public Health Evaluation of Soil Sampling Data in Greenwich, Fairfield County, Connecticut, February 17, 2016. #journal#. 2016. #volume#:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017214		✓					No		No new data on PCBs in soil	Applicability and Utility	Health risk assessment for arsenic in soil near a school in CT.
5017634	RefID 5017634 N. L. Devi, I. C. Yadav, P. Chakraborty, Q. Shihua. Polychlorinated Biphenyls in Surface Soil from North-East India: Implication for Sources Apportionment and Health-Risk Assessment. Archives of Environmental Contamination and Toxicology. 2018. 75:377-389 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017634		✓						Supplemental	Non-US data, but multiple congeners measured	--	60 surface soil samples collected from 3 mountain states in northeast India in 2010; analyzed for 25 PCB congeners; overall, sum of PCBs ranged from 0.00159 to 0.0217 µg/g dw (median = 0.00578 µg/g); total PCBs mostly dominated by tetra-, penta-, and tri-PCBs; PCBs 49, 52, 28, and 44 were most abundant.
5017666	RefID 5017666 V. Ivanescu. Human Health Risk Assessment Posed by PCB Exposure in Bucharest Area. #journal#. 2015. 6:453-458 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017666		✓					No		No new data on PCBs in soil	Applicability and Utility	Human health risk assessment using data from a previous study (Sandu et al. 2013) and risk assessment software.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
507760	RefID 507760 R. T. Ottesen, J. Alexander, M. Langedal, T. Haugland, E. Hoygaard. Soil pollution in day-care centers and playgrounds in Norway: national action plan for mapping and remediation. Environmental Geochemistry and Health. 2008. 30:623-637 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/507760		✓					No		Limited number of congeners analyzed	Applicability and Utility	"Presents development of methods and results obtained in the studies of urban soil pollution and health risk evaluation in Trondheim, Bergen and Oslo" Norway; summarizes sampling procedures and pollution mapping from various studies; reports median soil concentration (sum of 7 PCBs) as <0.001 µg/g for Trondheim soil (4-5 cm depth), 0.014 µg/g for Bergen inner city surface soil and 0.003 µg/g for Bergen outer city surface soil, and 0.02 µg/g for Bergen daycare and playgrounds.
587465	RefID 587465 X. Tang, C. Shen, D. Shi, S. A. Cheema, M. I. Khan, C. Zhang, Y. Chen. Heavy metal and persistent organic compound contamination in soil from Wenling: An emerging e-waste recycling city in Taizhou area, China. Journal of Hazardous Materials. 2010. 173:653-660 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/587465		✓						Supplemental	Non-US data, but multiple congeners measured	--	Surface soils collected from an e-waste recycling site (n=38) in Wenling, China and at a reference site (n=1) in 2008; analyzed for 58 PCB congeners, including 6 indicator PCBs; PCBs were detectable in all the samples; total concentrations ranged from 0.0520 to 5.7895 µg/g dw at the recycling sites, and was 0.0249 µg/g at the reference site; tri-tetra- and penta- congeners were the most prevalent.
198230	RefID 198230 E. Priha, S. Hellman, J. Sorvari. PCB contamination from polysulphide sealants in residential areas-exposure and risk assessment. Chemosphere. 2005. 59:537-43 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198230		✓						Already in Tool	--	--	"Average background PCB concentration levels in parks are 0.025 mg/kg (dw) (city of Tampere) and 0.053 mg/kg (dw) (city of Helsinki)" Finland.
2156750	RefID 2156750 T. Chafik. Evaluation of the Soil Contamination of Tangier		✓					No		No new data on PCBs in soil	Applicability and Utility	Erratum for Zouir et al., 2009.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	(Morocco) by the Determination of BTEX, PCBs, and PAHs (vol 18, pg 535, 2009). Soil and Sediment Contamination. 2009. 18:766-766 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2156750											
198222	RefID 198222 E. Menichini, N. Iacovella, F. Monfredini, L. Turrio-Baldassarri. Relationships between indoor and outdoor air pollution by carcinogenic PAHs and PCBs. Atmospheric Environment. 2007. 41:9518-9529 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198222			✓	✓				Supplemental	Non-US data, but multiple congeners measured	--	Samples collected inside and outside 3 homes in Rome; analyzed for 62 PCB congeners in air; no obvious sources of PCBs; homes built before PCB ban; non=detects set to 1/2 detection limit; indoor concentrations ranged from 6.5 to 33 ng/m^3; outdoor concentrations ranged from 1.9 to 5.4 ng/m^3.
2154635	RefID 2154635 P. Bohlin, K. C. Jones, H. Tovalin, B. Strandberg. Observations on persistent organic pollutants in indoor and outdoor air using passive polyurethane foam samplers. Atmospheric Environment. 2008. 42:7234-7241 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2154635			✓	✓				Supplemental	Non-US data, but multiple congeners measured	--	Indoor (n=35) and outdoor (n=11) air samples were collected in 2006 from urban and semi-rural sites in Mexico City, Sweden and the UK and analyzed for 43 (tri-octa) PCB congeners; indoor total PCB concentrations ranged from 0.21 to 0.84 ng/m^3 (mean = 0.47 ng/m^3) for urban Mexico, 0.1 to 0.32 ng/m^3 (mean = 0.19 ng/m^3) for semi-urban Mexico, 0.33 to 1.6 ng/m^3 (mean = 0.89 ng/m^3) for Sweden, and 0.15 to 2.1 ng/m^3 (mean = 0.86 ng/m^3) for the UK; outdoor concentrations ranged from 0.23 to 0.66 ng/m^3 (mean = 0.44 ng/m^3) for urban Mexico, 0.087 to 0.21 ng/m^3 (mean = 0.15 ng/m^3) for semi-urban Mexico, 0.059 to 0.17 ng/m^3 (mean = 0.12 ng/m^3) for Sweden, and 0.12 ng/m^3 for the UK.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2920071	RefID 2920071 M. D. Ampleman, A. Martinez, J. Dewall, D. F. Rawn, K. C. Hornbuckle, P. S. Thorne. Inhalation and dietary exposure to PCBs in urban and rural cohorts via congener-specific measurements. Environmental Science and Technology. 2015. 49:1156-1164 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920071			✓	✓	✓	Yes for Indoor air	No for outdoor air	Supplemental for dietary	US locations for indoor air No data for outdoor air Non-US population for dietary	Applicability and Utility for outdoor air and dietary	Indoor and outdoor air samples were analyzed for 201 PCB congeners; geometric mean total PCB indoor air concentrations were 1.0 ± 0.02 ng/m^3 for East Chicago, IN homes (n=34) and 0.44 ± 0.1 ng/m^3 for Columbus Junction, IA homes (n=35); arithmetic mean total PCB indoor air concentrations were 6.4 ± 0.1 ng/m^3 (n = 13) at East Chicago schools and 8.4 ± 0.4 ng/m^3 (n=11) for Columbus Junction schools; outdoor samples had concentrations that were 10 fold lower than indoor concentrations. Uses dietary data from older Canadian Total Diet Studies; dietary exposure estimated to be 66-108 ug/year for children and 74-83 µg/year for mothers; this would be equivalent to about 0.006-0.01 µg/kg-day for a 30 kg child and 0.003 µg/kg-day for a 70 kg adult based on EPA calculations (see Figure 4 pie charts in paper).
2933285	RefID 2933285 R. F. Marek, T. Schulz, D. Hu, J. Dewall, P. S. Thorne, K. C. Hornbuckle. PCBs in indoor and outdoor air from urban and rural US homes and schools. Abstracts of Papers - American Chemical Society. 2014. 248:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2933285			✓	✓			No		Abstract only; no data provided	Evaluation and Review	Abstract only.
2940146	RefID 2940146 T. Schulz, D. Hu, P. Thorne, J. Dewall, K. Hornbuckle. Indoor and outdoor airborne PCBs in residential areas of East Chicago, IN and Columbus Junction, IA. Abstracts of Papers - American Chemical Society. 2013. 246:#pages#			✓	✓			No		Abstract only; no data provided	Evaluation and Review	Abstract only.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2940146											
3350781	RefID 3350781 Q. Dai, X. Min, M. Weng. A review of polychlorinated biphenyls (PCBS) pollution in indoor air environment. Journal of the Air and Waste Management Association. 2016. 66:941-950 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3350781			✓	✓			No		No new data on PCBs in air	Applicability and Utility	Literature review; "introduces the industrial application and potential harm of PCBs, summarizes the sampling, extracting, and analytical methods of environment monitoring, and compares the indoor air levels of urban areas with those of industrial areas in different countries according to various reports"; no new PCB data for indoor or outdoor environments.
3984192	RefID 3984192 R. F. Marek, P. S. Thorne, N. J. Herkert, A. M. Awad, K. C. Hornbuckle. Airborne PCBs and OH-PCBs Inside and Outside Urban and Rural U.S. Schools. Environmental Science and Technology. 2017. 51:7853-7860 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3984192			✓	✓		Yes			Data for U.S. background location; multiple congeners measured	--	Evaluated indoor and outdoor air concentrations (n=108) of PCBs from two rural schools and four urban schools in Indiana and Iowa in 2012-2015, one near a PCB-contaminated waterway of Lake Michigan; analyzed for all 209 PCB congeners; concentrations of the sum of PCBs ranged from 0.03 to 3 ng/m^3 outdoors and 0.5 to 194 ng/m^3 indoors; median outdoor values for 5 of the schools were, 0.21, 0.584, 0.183, 0.36, and 0.159 ng/m^3 (see supplemental information for outdoor air values for the individual schools; outdoor data were not available for 1 rural school).
5017116	RefID 5017116 R. Marek, A. Awad, N. Herkert, P. Thorne, K. Hornbuckle. Airborne PCBs and OH-PCBs inside and outside rural schools and urban schools near Lake Michigan. Abstracts of Papers - American Chemical Society. 2017. 253:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017116			✓	✓			No		Abstract only	Evaluation and Review	Abstract only; indoor and outdoor air samples collected from 2 rural schools and 4 urban schools near Lake Michigan (n=108); analyzed for 209 congeners; concentrations ranged from 0.2 to 70 ng/m^3 indoors; 1-2 orders of magnitude lower outdoors.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
697309	RefID 697309 R. Rudel, R. Dodson, L. Perovich, R. Morello-Frosch, D. Camann, M. Zuniga, A. Yau, A. Just, J. Brody. Semivolatile endocrine-disrupting compounds in paired indoor and outdoor air in two northern California communities. Environmental Science and Technology. 2010. 44:6583-6590 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/697309			✓	✓			No		Limited number of congeners analyzed	Applicability and Utility	Paired indoor/outdoor air samples collected from 40 urban and 10 rural homes in northern California; analyzed for PCBs 52, 105, and 153; PCBs were not detected in outdoor samples; PCB 52 was detected in about half the indoor samples at concentrations ranging from < detection limit to 3.3 ng/m^3.
198177	RefID 198177 G. M. Currado, S. Harrad. Comparison of polychlorinated biphenyl concentrations in indoor and outdoor air and the potential significance of inhalation as a human exposure pathway. Environmental Science and Technology. 1998. 32:3043-3047 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198177			✓	✓				Already in Tool	--	--	Observed an average indoor air concentration of 9 ng/m^3 (range = 1.1 to 69 ng/m^3) based on indoor air samples collected from 7 university buildings (2 laboratories and 5 offices) and 7 homes in England in 1996-1998; observed concentrations of total PCBs (tri- through hepta- chlorinated congeners) in 25 samples of outdoor air in Birmingham, England that averaged 0.31 ng/m^3 (range = 0.08 to 1.5 ng/m^3).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198192	RefID 198192 S. Harrad, S. Hazrati, C. Ibarra. Concentrations of polychlorinated biphenyls in indoor air and polybrominated diphenyl ethers in indoor air and dust in Birmingham, United Kingdom: Implications for human exposure. Environmental Science and Technology. 2006. 40:4633-4638 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198192			✓					Supplemental	Non-US data, but multiple congeners measured	--	Collected air samples in 31 homes, 33 offices, 25 cars, and 3 public microenvironments in West Midlands, UK in 2003 and 2005; total PCBs were estimated as 5 times the sum of 6 congeners (28, 52, 101, 138, 153, and 180); average air concentrations were 2.8 ng/m^3 (range = 0.487 to 9.764 ng/m^3) for homes); 18.1 ng/m^3 (range = 0.816 to 101.8 ng/m^3) for offices, and 30.7 ng/m^3 (range = 1.08 to 81.5 ng/m^3) for public microenvironments.
1082281	RefID 1082281 X. Zhang, M. L. Diamond, M. Robson, S. Harrad. Sources, emissions, and fate of polybrominated diphenyl ethers and polychlorinated biphenyls indoors in Toronto, Canada. Environmental Science and Technology. 2011. 45:3268-3274 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1082281			✓					Supplemental	Non-US data, but multiple congeners measured	--	Total PCBs from 20 indoor locations (homes, offices, laboratories) in Toronto, Canada; sum of PCBs = 5 times the sum of 6 indicator congeners; range = 0.8 to 130.5 ng/m^3; geometric median = 8.5 ng/m^3; geometric mean = 6.5 ng/m^3; congener pattern similar to Aroclor 1248, 1232, 1242.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198195	RefID 198195 S. Hazrati, S. Harrad. Causes of variability in concentrations of polychlorinated biphenyls and polybrominated diphenyl ethers in indoor air. Environmental Science and Technology. 2006. 40:7584-7589 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198195			✓				No		Appears to report on the same sampling sites as Harrad et al., 2006	Applicability and Utility	Air samples collected from 92 microenvironments in the UK, but the study only reports on 2 selected homes and 1 office where variations between rooms were studied (no indication of why these ones were selected); also studied seasonal variability and influence of room contents on concentrations; for 2 selected homes, average PCB air concentrations were 2.5 and 0.6 to 1.3 ng/m^3; for the selected office, concentrations were 1.3 to 1.6 ng/m^3.
198198	RefID 198198 B. Heinzow, S. Mohr, G. Ostendorp, M. Kerst, W. Körner. PCB and dioxin-like PCB in indoor air of public buildings contaminated with different PCB sources - Deriving toxicity equivalent concentrations from standard PCB congeners. Chemosphere. 2007. 67:1746-1753 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198198			✓				No		Contaminated area	Applicability and Utility	Samples collected from buildings in Germany suspected of having PCB sources; adjusted median background indoor air concentration of 15 ng/m^3 total PCBs. Note that they cite a German guideline level (similar to ELE) of 300 ng/m^3.
2150587	RefID 2150587 M. Frederiksen, H. W. Meyer, N. E. Ebbehøj, L. Gunnarsen. Polychlorinated biphenyls (PCBs) in indoor air originating from sealants in contaminated and uncontaminated apartments within the same housing estate. Chemosphere. 2012. 89:473-479 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150587			✓					Supplemental	Non-US data, but multiple congeners measured	--	Provides indoor air data for contaminated apartments in Denmark, but also provides a mean reference value for total PCBs of 6.03 ng/m^3 (from 20 uncontaminated apartments; 21 sampled but one excluded from mean due to likely PCB source); range = <LOQ to 30.6 ng/m^3; total PCBs were calculated as 5 times the sum of the 6 indicator PCBs.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2151223	RefID 2151223 E. F. Fitzgerald, S. Shrestha, P. M. Palmer, L. R. Wilson, E. E. Belanger, M. I. Gomez, M. R. Cayo, S. A. Hwang. Polychlorinated biphenyls (PCBs) in indoor air and in serum among older residents of upper Hudson River communities. Chemosphere. 2011. 85:225-231 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151223			✓			Yes			Data for U.S. background location; multiple congeners measured	--	Mean indoor air PCB concentration for 176 homes (92 from the study area and 84 from the comparison site) in upper Hudson River, New York communities was 14 ng/m^3 (ranging = 0.6 to 233 ng/m^3); since the PCB levels between the study and comparison areas did not differ significantly the results from both areas were combined; "PCB standard preparation was performed using a congener calibration set representing a mix of Aroclors 1242, 1254, and 1260"; 84 congeners measured; results are for total PCBs; PCB 28 had the highest average concentration.
2152167	RefID 2152167 L. R. Wilson, P. M. Palmer, E. E. Belanger, M. R. Cayo, L. A. Durocher, S. A. Hwang, E. F. Fitzgerald. Indoor air polychlorinated biphenyl concentrations in three communities along the Upper Hudson River, New York. Archives of Environmental Contamination and Toxicology. 2011. 61:530-538 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152167			✓				No		Appears to report on the same sampling sites as Fitzgerald et al., 2011	Applicability and Utility	Indoor air samples from homes near a contaminated site and reference site in New York have similar concentrations; total PCBs represents sum of 84 congeners identified; study area (n=147) mean = 12.8 ng/m^3, median = 7.9 ng/m^3 (range = 0.3-114.3 ng/m^3); reference site (n=136) mean = 12.9 ng/m^3, median = 6.8 ng/m^3 (range = 0.3-233.3 ng/m^3).
2152774	RefID 2152774 R. F. Herrick. Herrick's response to Newman's PCBs in schools: what about school maintenance workers? New Solutions: A Journal of Environmental and Occupational Health Policy. 2010. 20:193-194 https://heronet.epa.gov/heronet/			✓				No		No new data on PCBs in indoor air	Applicability and Utility	Short discussion of PCB exposure among construction workers; no information on media concentrations.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	index.cfm/reference/download/reference_id/2152774											
2152777	RefID 2152777 D. M. Newman. PCBs in schools: what about school maintenance workers?. New Solutions: A Journal of Environmental and Occupational Health Policy. 2010. 20:189-191 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152777			✓				No		No new data on PCBs in indoor air	Applicability and Utility	Overview of issues related to exposure among construction workers from building materials; no data on media concentrations.
2153217	RefID 2153217 R. F. Herrick. PCBs in school-persistent chemicals, persistent problems. New Solutions: A Journal of Environmental and Occupational Health Policy. 2010. 20:115-126 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153217			✓				No		No new data on PCBs in indoor air	Applicability and Utility	Overview of issues related to use of caulk in buildings; no media data.
2153321	RefID 2153321 R. Barro, J. Regueiro, M. Llompart, C. Garcia-Jares. Analysis of industrial contaminants in indoor air: Part 1. Volatile organic compounds, carbonyl compounds, polycyclic aromatic hydrocarbons and polychlorinated biphenyls. Journal of Chromatography A. 2009. 1216:540-566 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153321			✓				No		No new data on PCBs in indoor air	Applicability and Utility	Review of literature; no new PCB information.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2161962	RefID 2161962 E. Fitzgerald, E. Belanger, P. Palmer, L. Wilson, R. Narang, S. Hwang. Residential Indoor Air Exposure to Polychlorinated Biphenyls. Epidemiology. 2009. 20:S152-S152 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2161962			✓				No		Abstract only	Evaluation and Review	Conference abstract only; assessed the association between indoor air and serum PCB concentrations in older long-term residents near a Superfund site in New York; serum and air samples collected for 176 participants; 12 congeners frequently detected; indoor air concentrations for 12 congeners averaged 14 ng/m^3; significant association between concentrations of PCBs 28 and 105 in air and serum; see Fitzgerald et al. 2011 for full paper.
2180609	RefID 2180609 E. B. Pedersen, P. Jacobsen, H. W. Meyer, C. Brauer, N. E. Ebbehoj, T. Goeen. Indoor environmental exposure to polychlorinated biphenyls. Clinical Toxicology. 2013. 51:330-331 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2180609			✓				No		Abstract only; no data provided	Evaluation and Review	Conference abstract only; evaluated serum concentrations of PCBs in people working in a building with PCB sealants and in unexposed individuals; no indoor air data provided.
3458632	RefID 3458632 V. Kauneliene, T. Prasauskas, E. Krugly, I. Stasiulaitiene, D. Ciuzas, L. Seduikyte, D. Martuzevicius. Indoor air quality in low energy residential buildings in Lithuania. Building and Environment. 2016. 108:63-72 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3458632			✓				No		Results not reported in units needed	Clarity and Completeness	Measured PCBs in the indoor air of 11 single-family residential newly built low energy buildings in Lithuania in 2014; PCBs concentrations reported as 1.8 to 3.8 (mean = 2.7) ng/semi-permeable membrane device/day and were dominated by di- and tri-CBs.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198202	RefID 198202 R. F. Herrick, M. D. Mcclean, J. D. Meeker, L. K. Baxter, G. A. Weymouth. An unrecognized source of PCB contamination in schools and other buildings. Environmental Health Perspectives. 2004. 112:1051-1053 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198202			✓				No		Already cited in Tool to represent contaminated building	Applicability and Utility	Midpoint of the range of detected PCBs (111 to 393 ng/m^3) for 18 air samples from 2 university buildings in the greater Boston area with PCB contamination was 250 ng/m^3.
1256048	RefID 1256048 W. Han, J. Feng, Z. Gu, M. Wu, G. Sheng, J. Fu. Polychlorinated biphenyls in the atmosphere of Taizhou, a major e-waste dismantling area in China. Journal of Environmental Sciences. 2010. 22:589-597 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1256048				✓			No		Contaminated area	Applicability and Utility	Data from a contaminated ewaste recycling site in China; showed that ambient air concentrations at site were 54 times higher than at a reference site; related to study by Xing et al. 2011.
1800148	RefID 1800148 S. Baek, J. Jurng, Y. S. Chang. Spatial distribution of polychlorinated biphenyls, organochlorine pesticides, and dechlorane plus in Northeast Asia. Atmospheric Environment. 2013. 64:40-46 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1800148				✓			No		Results not reported in units needed	Applicability and Utility	Conducted passive air sampling for 209 PCB congeners in 8 cities in Northeast Asia; results provided as pg/day.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
198185	RefID 198185 R. W. Gale, W. L. Cranor, D. A. Alvarez, J. N. Huckins, J. D. Petty, G. L. Robertson. Semivolatile organic compounds in residential air along the Arizona-Mexico border. Environmental Science and Technology. 2009. 43:3054-60 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198185				✓			No		Results not reported in units needed	Applicability and Utility	Collected air samples over a 30-day period in 4 locations within each of 52 homes along the Arizona-Mexico border using semi-permeable membrane devices (SPMD); PCBs were detected in 56% of the samples at amounts ranging from 1.1 to 13 ng/composite of 4 SPMD (mean = 3 ng/composite of 4 SPMD); results not provided as ng/m^3.
2150813	RefID 2150813 R. Lohmann, J. Klanova, P. Kukucka, S. Yonis, K. Bollinger. PCBs and OCPs on a east-to-west transect: the importance of major currents and net volatilization for PCBs in the Atlantic Ocean. Environmental Science and Technology. 2012. 46:10471-10479 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150813				✓			No		No data on PCBs in air	Applicability and Utility	Study to determine POPs' gradients in air, water, and their air−water exchange. No data on PCBs in air.
2150880	RefID 2150880 A. L. Sandy, J. Guo, R. J. Miskewitz, W. R. Mcgillis, L. A. Rodenburg. Fluxes of polychlorinated biphenyls volatilizing from the Hudson River, New York measured using micrometeorological approaches. Environmental Science and Technology. 2012. 46:885-891 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150880				✓			No		Contaminated area	Applicability and Utility	Samples (n=13) collected from a contaminated site (Hudson River); total PCB concentrations averaged 1.1 ng/m^3 (range = 0.62 to 2.2 ng/m^3) above water column.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2150915	RefID 2150915 J. N. Hogarh, N. Seike, Y. Kobara, A. Habib, J. J. Nam, J. S. Lee, Q. Li, X. Liu, J. Li, G. Zhang, S. Masunaga. Passive air monitoring of PCBs and PCNs across East Asia: a comprehensive congener evaluation for source characterization. Chemosphere. 2012. 86:718-726 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150915				✓				Supplemental	Non-US data, but multiple congeners measured	--	Analyzed rural, suburban, and urban air samples in Asia (55 in Japan, 20 in China, and 30 in Korea) for total PCBs; mean concentrations of the sum of 202 congeners were 0.184 ± 0.024, 1.1 ± 0.118, and 0.156 ± 0.02 ng/m^3 for Japan, China and Korea, respectively.
2152444	RefID 2152444 J. K. Schuster, R. Gioia, A. J. Sweetman, K. C. Jones. Temporal trends and controlling factors for polychlorinated biphenyls in the UK atmosphere (1991-2008). Environmental Science and Technology. 2010. 44:8068-8074 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152444				✓			No		Limited number of congeners analyzed	Applicability and Utility	Long-term monitoring of air concentrations of 8 PCB congeners at 2 rural, 1 semi-rural, and 3 urban monitoring sites in the UK; n=260 quarterly samples; urban concentrations were higher than rural concentrations; half-life mean = 4.7±1.6 years (range = 2.3 to 8.9 years).
2152699	RefID 2152699 A. Birgül, Y. Tasdemir. Seasonal atmospheric deposition variations of polychlorinated biphenyls (PCBs) and comparison of some deposition sampling techniques. Environmental Science and Pollution Research. 2011. 18:396-406 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152699				✓				Supplemental	Non-US data, but multiple congeners measured	--	Ambient air PCB concentrations (n=70) and bulk deposition (n=25) measured in semi-rural area in Turkey in 2008/9; 83 PCB congeners targeted; average gas and particle PCB concentrations were 0.393 ± 0.278 and 0.070 ± 0.102 ng/m^3, respectively; 85% of atmospheric PCBs in gas phase; highest concentrations observed in summer.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2153059	RefID 2153059 L. Zhang, R. Lohmann. Cycling of PCBs and HCB in the surface ocean-lower atmosphere of the open Pacific. Environmental Science and Technology. 2010. 44:3832-3838 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153059				✓			No		Limited number of congeners analyzed	Applicability and Utility	Marine boundary layer air samples collected during a cruise between San Diego, CA and Samoa, and Samoa and New Zealand; analyzed for 13 PCB congeners; mean sum of 13 PCBs = 0.094 (range 0.059 to 0.169) ng/m^3 in the northern hemisphere and 0.025 (0.0039 to 0.067) ng/m^3 in the southern hemisphere.
2153805	RefID 2153805 J. Klánová, P. Cupr, I. Holoubek, J. Borůvková, P. Pribylová, R. Kares, T. Tomsej, T. Ocelka. Monitoring of persistent organic pollutants in Africa. Part 1: passive air sampling across the continent in 2008. Journal of Environmental Monitoring. 2009. 11:1952-1963 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153805				✓			No		Limited number of congeners analyzed; results not reported in units needed	Applicability and Utility	6-month air sampling across 26 sites in 15 African countries; sites included rural and urban background, and industrial and agricultural; analyzed for 7 PCB congeners (28, 52, 101, 118, 153, 138, 180); results provided as pg/sample, except they report that the highest concentration was for Senegal at 0.5 to 1 ng/m^3.
2154627	RefID 2154627 V. Bogillo, M. Bazylevska. Variations of organochlorine contaminants in Antarctica. #journal#. 2008. #volume#:251-267 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2154627				✓			No		Model	Applicability and Utility	Models used to estimate distribution patterns of chemicals in the global environment.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2154673	RefID 2154673 S. Du, S. I. Wall, D. Cacia, L. A. Rodenburg. Passive air sampling for polychlorinated biphenyls in the Philadelphia metropolitan area. Environmental Science and Technology. 2009. 43:1287-1292 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2154673				✓			No		Results not reported in units needed	Applicability and Utility	Passive air samples collected at 32 sites across Philadelphia, PA and Camden, NJ from April to July 2005; analyzed for 97 PCB congeners; results reported in mass of PCBs per location (ng); mass of total PCBs ranged from 21 to 700 ng; downtown Camden and Philadelphia sites had the highest PCB masses; results suggest that low molecular weight Aroclors (1242, 1248) comprise a substantial fraction of the gas-phase PCBs.
2155598	RefID 2155598 L. Nizzetto, C. Pastore, X. Liu, P. Camporini, D. Stroppiana, B. Herbert, M. Boschetti, G. Zhang, P. A. Brivio, K. C. Jones, A. Di Guardo. Accumulation parameters and seasonal trends for PCBs in temperate and boreal forest plant species. Environmental Science and Technology. 2008. 42:5911-5916 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2155598				✓			No		Limited number of congeners analyzed	Applicability and Utility	PCB concentrations measured in air and foliage in Italian forest to estimate bioconcentration factors in vegetation in 2005; 13 air samples analyzed for 33 congeners; sum of 8 congeners (28/31, 52, 101, 118, 138, 153, 180) in air averaged 0.035 ng/m^3; tr- and tera- PCBs dominated.
2156999	RefID 2156999 S. Yan, L. A. Rodenburg, J. Dachs, S. J. Eisenreich. Seasonal air-water exchange fluxes of polychlorinated biphenyls in the Hudson River Estuary. Environmental Pollution. 2008. 152:443-451 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2156999				✓		Yes			US locations; multiple congeners	--	PCBs were measured in air over water in the Hudson Bay Estuary (heavily impacted site) in 1999-2001 and a coastal Atlantic Ocean site and 2 sites over land (Jersey City and Sandy Hook); analyzed for 90 gas and particulate phase PCB congeners; mean total gas phase PCBs were 1.1 ng/m^3 for the Hudson River site, 0.25 ng/m^3 for the coastal Atlantic site, and 0.7 ng/m^3 (n=8; range = 0.18-1.3 ng/m^3) and 1.2 ng/m^3 (n=14; range = 0.48-2.4 ng/m^3) for the over land sites; mean particulate phase concentrations ranged from 0.017 to 0.082 ng/m^3.

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							Yes	No	Other			
2158432	RefID 2158432 M. Mandalakis, E. G. Stephanou. Atmospheric concentration characteristics and gas-particle partitioning of PCBs in a rural area of eastern Germany. Environmental Pollution. 2007. 147:211-221 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2158432				✓				Supplemental	Non-US data, but multiple congeners measured	--	14 air samples collected from rural sites in Eastern Germany in 2001; analyzed for 54 PCB congeners; average air (vapor plus particulate) total PCB concentration ranged from 0.036 to 0.374 ng/m^3 (mean = 0.11 ± 0.080 ng/m^3); 95% of total in vapor phase; composition closely resembled Aroclor 1232; sum of 5 congeners (28, 18, 31, 8+5, 52) accounted for nearly 40% of total.
2160588	RefID 2160588 F. M. Jaward, A. Di Guardo, L. Nizzetto, C. Cassani, F. Raffaele, R. Ferretti, K. C. Jones. PCBs and selected organochlorine compounds in Italian mountain air: the influence of altitude and forest ecosystem type. Environmental Science and Technology. 2005. 39:3455-3463 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2160588				✓			No		Results not reported in units needed	Applicability and Utility	Passive air samplers used to evaluate PCBs in rural Italian Alps; 39 samplers deployed over 2 sampling periods at 4 altitudes in 2003; analyzed for 29 PCB congeners; results reported as pg/day, except at 1 site where both a passive and high volume sampler were used; the sum PCBs for this site ranged from 0.025 to 0.052 ng/m^3 based on passive sampling and 0.035 to 0.125 ng/m^3 based on high volume sampling.
2160668	RefID 2160668 S. Eckhardt, K. Breivik, Y. F. Li, S. Mano, A. Stohl. Source regions of some persistent organic pollutants measured in the atmosphere at Birkenes, Norway. Atmospheric Chemistry and Physics. 2009. 9:6597-6610 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2160668				✓			No		Modeled values	Applicability and Utility	Modified atmospheric transport model; simulated atmospheric transport of persistent organic pollutants; modeled values were compared to measured annual emissions of PCB 28.

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							Yes	No	Other			
2162520	RefID 2162520 F. M. Jaward, N. J. Farrar, T. Harner, A. J. Sweetman, K. C. Jones. Passive air sampling of PCBs, PBDEs, and organochlorine pesticides across Europe. Environmental Science and Technology. 2004. 38:34-41 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2162520				✓				Supplemental	Non-US data, but multiple congeners measured	--	Conducted passive sampling in remote/rural/urban locations in 22 European countries in 2002 (n=71 samples); analyzed air samples for 29 PCB congeners; concentration of the sum of 29 congeners ranged from 0.020 to 1.7 ng/m^3.
2163589	RefID 2163589 R. Gioia, R. Lohmann, J. Dachs, C. Temme, S. Lakaschus, D. Schulz-Bull, I. Hand, K. C. Jones. Polychlorinated biphenyls in air and water of the North Atlantic and Arctic Ocean. Journal of Geophysical Research: Atmospheres. 2008. 113:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2163589				✓			No		Data for air over seawater	Applicability and Utility	37 air samples collected during a cruise from Germany through the Norwegian Sea, Greenland Sea, and Arctic Ocean in 2004; analyzed for 29 PCB congeners; concentrations of the sum of 29 congeners ranged from 0.022 to 0.25 (mean = 0.083) ng/m^3 in the Norwegian Sea, 0.01 to 0.085 (mean = 0.030) ng/m^3 in the Greenland Sea, and 0.0033 to 0.13 (mean = 0.021) ng/m^3 in the Arctic Ocean; sum of 8 PCB congeners (28, 52, 90/101, 118, 138, 153, 180) ranged from 0.006 to 0.1 (mean = 0.03) ng/m^3, 0.0035 to 0.022 (mean = 0.009) ng/m^3, and 0.00076 to 0.043 (mean = 0.007) ng/m^3 for the 3 water bodies, respectively.
2164983	RefID 2164983 A. K. Halse, M. Schlabach, S. Eckhardt, A. Sweetman, K. C. Jones, K. Breivik. Spatial variability of POPs in European background air. Atmospheric Chemistry and Physics. 2011. 11:1549-1564 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2164983				✓			No		Limited number of congeners analyzed	Applicability and Utility	Passive air samples collected at 86 background sites in 34 European countries in 2006; analyzed for 7 PCB congeners; concentrations of the sum of 7 congeners ranged from 0.002 to 0.121 ng/m^3 (mean = 0.021 ± 0.019 ng/m^3; median = 0.017 ng/m^3).

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							Yes	No	Other			
2181549	RefID 2181549 P. Pribylova, R. Kares, J. Boruvkova, P. Cupr, R. Prokes, J. Kohoutek, I. Holoubek, J. Klanova. Levels of persistent organic pollutants and polycyclic aromatic hydrocarbons in ambient air of Central and Eastern Europe. Atmospheric Pollution Research. 2012. 3:494-505 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2181549				✓			No		Limited number of congeners analyzed	Applicability and Utility	Passive air samples collected at 155 sites in 22 countries between 2006 and 2008; analyzed for 7 PCB congeners (28, 52, 101, 118, 153, 138, 180); data for the sum of 7 congeners reported as µg/sample; range = 1 to 96 µg/sample.
2183838	RefID 2183838 M. M. T. Sekulic, J. R. Radonic, M. B. Vojinovic-Miloradov, N. V. Senk, M. S. Okuka. ASSESSMENT OF ATMOSPHERIC DISTRIBUTION OF POLYCHLORINATED BIPHENYLS AND POLYCYCLIC AROMATIC HYDROCARBONS USING POLYPARAMETER MODEL. Hemijska Industrija. 2011. 65:371-380 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2183838				✓			No		Not in English	Evaluation and Review	NA

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2184279	RefID 2184279 C. Shunthirasingham, R. Barra, G. Mendoza, M. Montory, C. E. Oyiliagu, Y. D. Lei, F. Wania. Spatial variability of atmospheric semivolatile organic compounds in Chile. Atmospheric Environment. 2011. 45:303-309 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2184279				✓				Supplemental	Non-US data, but multiple congeners measured	--	Air samples collected by passive samplers at 20 sites at various elevation gradients in Chile in 2006-2007; analyzed for 56 PCB congeners; concentrations of sum of 56 congeners ranged from 0.0002 to 0.027 ng/m^3.
2189720	RefID 2189720 A. Zouir, F. A. Esteve-Turrillas, A. Morales-Rubio, T. Chafik, A. Pastor, M. de La Guardia. Use of semipermeable membrane devices for assessment of air quality in Tangier (Morocco). International Journal of Environmental Analytical Chemistry. 2009. 89:917-928 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2189720				✓			No		Limited number of congeners analyzed	Applicability and Utility	Air was sampled at 6 urban and industrial sites in Tangier, Morocco; analyzed for 6 PCB congeners (28, 52, 101, 138, 153, 180); PCBs were not found in any of the samples.
2536095	RefID 2536095 H. Nie, S. Fu, Y. Dong, Z. Yang. Polychlorinated biphenyls in respirable particulate matter from different industrial areas in northern China. Chemosphere. 2014. 114:210-218 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2536095				✓			No		Particulate matter only	Applicability and Utility	Measured respirable PCBs in 22 air samples (11 PM2.5 and 11 PM 2.5-10) from 2 Chinese industrial cities; analyzed for 144 PCB congeners; total PCB concentrations were 0.00592–0.0387 ng/m^3 (median = 0.02158 ng/m^3) in PM2.5 and 0.00183–0.0408 ng/m^3 (median = 0.0243 ng/m^3) in PM2.5–10 in Linfen, and 0.00433–0.0185 ng/m^3 (median = 0.0119 ng/m^3) in PM2.5 and 0.0130–0.0474 ng/m^3 (median = 0.0174 ng/m^3) in PM2.5–10 in Datong; tri-CBs dominated.

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							Yes	No	Other			
2673675	RefID 2673675 C. J. Gallban-Malagon, S. Del Vento, A. Cabrerizo, J. Dachs. Factors affecting the atmospheric occurrence and deposition of polychlorinated biphenyls in the Southern Ocean. Atmospheric Chemistry and Physics. 2013. 13:12029-12041 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2673675				✓			No		Data for air over seawater	Applicability and Utility	Air samples collected over the Southern ocean in 2005, 2008, and 2009 during cruises around the Antarctic Peninsula; analyzed for 25 PCB congeners; gas phase concentration of the sum of PCBs ranged from 0.001 to 0.070 ng/m^3.
2684612	RefID 2684612 A. Awad, A. Martinez, R. Marek, W. Koh, K. Hornbuckle. Particulate PCBs and OH-PCBs in Chicago air. Abstracts of Papers - American Chemical Society. 2013. 246:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2684612				✓			No		No data on PCBs in air	Evaluation and Review	Abstract only; evaluated PCBs in particulates in air; developed method to evaluate OH-PCBs.
2689481	RefID 2689481 R. Gioia, M. Macleod, J. Castro-Jimenez, L. Nizzetto, J. Dachs, R. Lohmann, K. C. Jones. Diurnal Variability of Persistent Organic Pollutants in the Atmosphere over the Remote Southern Atlantic Ocean. #journal#. 2014. 5:622-634 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2689481				✓			No		Limited number of congeners analyzed	Applicability and Utility	Evaluated diurnal patterns of PCBs in air samples collected during a 2005 cruise in remote tropical South Atlantic; based on results for 6 PCB congeners (28, 52, 90/101, 138, 15.3, 180), daytime atmospheric concentrations were higher than nighttime concentration by a factor of 2-3 for more volatile congeners (28, 52, 0/101).
2696310	RefID 2696310 V. H. Estellano, K. Pozo, C. Silibello, M. D. Mulder, C. Efstathiou,				✓				Supplemental	Non-US data, but multiple	--	Passive air monitoring conducted at 4 locations (3 urban, 1 suburban) in Southern Italy in 2009; analyzed for 28 PCB congeners (26 were

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	M. P. Tomasino, F. Funaro, I. Donadio, S. Focardi. Characterization of urban pollution in two cities of the Puglia region in Southern Italy using field measurements and air quality (AQ) model approach. Atmospheric Pollution Research. 2014. 5:34-41 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2696310									congeners measured		frequently detected); concentrations of the sum of 26 PCBs ranged from 0.03 to 0.2 ng/m^3 (mean = 0.08 ± 0.05 ng/m^3).
2920031	RefID 2920031 X. Wang, K. Kennedy, J. Powell, M. Keywood, R. Gillett, P. Thai, P. Bridgen, S. Broomhall, C. Paxman, F. Wania, J. F. Mueller. Spatial distribution of selected persistent organic pollutants (POPs) in Australia's atmosphere. Environmental Science: Processes & Impacts. 2015. 17:525-532 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920031				✓				Supplemental	Non-US data, but multiple congeners measured	--	Passive air sampling conducted in Australia in 2012 at 15 sampling sites (remote/background, agricultural, semi-urban, urban); analyzed for 47 PCB congeners; concentrations of sum of PCBs ranged from 0.00073 to 0.072 ng/m^3 (median = 0.0089 ng/m^3); concentrations consistently higher at urban sites.

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							Yes	No	Other			
2923901	RefID 2923901 P. Shahpoury, G. Lammel, A. H. Smejkalova, J. Klanova, P. Pribylova, M. Vana. Polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and chlorinated pesticides in background air in central Europe - investigating parameters affecting wet scavenging of polycyclic aromatic hydrocarbons. Atmospheric Chemistry and Physics. 2015. 15:1795-1805 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2923901				✓			No		Limited number of congeners analyzed	Applicability and Utility	162 gas and particulate phase air samples collected in Czech Republic in 2011-2014; analyzed for 7 PCB congeners (28, 52, 101, 118, 138, 153, 180); sum of PCB concentrations in gas phase ranged from <LOQ to 0.0435 (mean = 0.0081 ± 0.0072) ng/m^3.
2929212	RefID 2929212 Wang Zhen,Na Guangshui,Gao Hui,Wang Yanjie,Yao Ziwei. Atmospheric concentration characteristics and gas/particle partitioning of PCBs from the North Pacific to the Arctic Ocean. Acta Oceanologica Sinica. 2014. 33:32-39 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2929212				✓			No		Data for air over seawater	Applicability and Utility	19 atmospheric samples collected in 2012 during cruise from North Pacific to Arctic Ocean; analyzed for 26 congeners; mean particulate plus vapor phase concentration of total PCBs was 0.019116 ± 0.013833 ng/m^3 (range = 0.007973 to 0.067657 ng/m^3); dominated by low-chlorinated congeners (di-, tri-, tetra-); congeners 28, 52, and 77 were most abundant.

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							Yes	No	Other			
3020305	RefID 3020305 M. Dvorscak, I. Beslic, S. Fingler, R. Godec, K. Sega, Z. Vasilic, V. Drevenkar. Organochlorine Pesticides and Polychlorinated Biphenyls in Atmospheric Particles Collected in Zagreb, Croatia. Croatica Chemica Acta. 2015. 88:179-188 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3020305				✓			No		Limited number of congeners analyzed	Applicability and Utility	Occurrence of 17 PCB congener studied in PM10 and PM 2.5 particle fractions in air in Croatia in 2000, 2003, and 2010; 183 samples analyzed for 6 indicator congeners and 153 samples also analyzed for 11 other congeners; most frequently detected congeners were 28, 138, 153, 52, 60, 118, and 101; "mass concentrations of PCBs in air, expressed as the sum of six PCB indicator congeners, ranged from 10.7 to 577.0 pg/m^3 [0.0107 to 0.577 ng/m^3] and in the particles in air from 0.12 to 111 pg/m^3 [0.00012 to 0.111 ng/m^3]."
3262123	RefID 3262123 A. Cincinelli, R. M. Dickhut. LEVELS AND TRENDS OF ORGANOCHLORINE PESTICIDES (OCPS) IN ANTARCTICA. #journal#. 2010. #volume#:143-164 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3262123				✓			No		No data on PCBs	Applicability and Utility	Provides an "overview of the most important processes that determine transport and fate of POPs in Antarctica" and reviews the "scientific literature on levels of organochlorine pesticides (OCPs) in air, sea-water, sea/ice, sediments, snow, ice and plankton in Antarctica"; no PCB data.
3350696	RefID 3350696 A. E. Sakin, Y. Tasdemir. Determination of Atmospheric PCB Level Variations in Continuously Collected Samples. Archives of Environmental Contamination and Toxicology. 2016. 71:235-245 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3350696				✓				Supplemental	Non-US data, but multiple congeners measured	--	48 ambient air samples collected at a semi-rural university in Turkey in 2013; analyzed for 87 PCB congeners in the gas and particle phases; sum of congeners ranged from 0.00063 to 0.897 ng/m^3 (mean = 0.293 ± 0.257 ng/m^3) in the gas phase and 0.007 to 0.285 ng/m^3 (mean = 0.052 ± 0.056 ng/m^3) in the particle phase; gas phase summer concentrations higher than winter concentrations.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
3351205	RefID 3351205 P. S. Diefenbacher, A. C. Gerecke, C. Bogdal, K. Hungerbühler. Spatial Distribution of Atmospheric PCBs in Zurich, Switzerland: Do Joint Sealants Still Matter?. Environmental Science and Technology. 2016. 50:232-239 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3351205				✓			No		Limited number of congeners analyzed	Applicability and Utility	Air samples collected at 23 sites across Zurich, Switzerland in 2011 and 2013; analyzed for 6 indicator PCBs (28, 52, 101, 138, 153, 180); 2011 concentrations ranged from 0.080 to 0.723 (median = 0.172) ng/m^3; 2013 concentrations ranged from 0.054 to 3.16 (median = 0.154) ng/m^3.
3352142	RefID 3352142 R. A. Hites. A Statistical Approach for Left-Censored Data: Distributions of Atmospheric Polychlorinated Biphenyl Concentrations near the Great Lakes as a Case Study. Environmental Science & Technology Letters. 2015. 2:250-254 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3352142				✓			No		Limited number of congeners analyzed	Applicability and Utility	Approach for handling left censored data using PCB data for the Great Lakes as an example; discussion limited to 9 PCB congeners of the 80 for which analyses are available in the Integrated Atmospheric Deposition Network.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
3604873	RefID 3604873 A. Birgül, P. B. Kurt-Karakus, H. Alegria, E. Gungormus, H. Celik, T. Cicek, E. C. Güven. Polyurethane foam (PUF) disk passive samplers derived polychlorinated biphenyls (PCBs) concentrations in the ambient air of Bursa-Turkey: Spatial and temporal variations and health risk assessment. Chemosphere. 2017. 168:1345-1355 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3604873				✓				Supplemental	Non-US data, but multiple congeners measured	--	Measured atmospheric levels of PCBs at 8 sampling sites (1 rural, 2 urban, 2 semi-urban, 2 industrial, 1 agricultural) in Bursa, Turkey in 2014; analyzed for 43 PCB congeners; over all sites, total PCBs ranged from 0.0096 (agricultural site) to 1.240 ng/m^3 (industrial site); mean total PCB concentrations were 0.024 ± 0.0082 ng/m^3 for the rural site, 0.0438 ± 0.0244 and 0.18 ± 0.21 ng/m^3 for the 2 semi-urban sites, 0.0429 ± 0.0246 and 0.16 ± 0.28 ng/m^3 for the 2 urban sites, 0.0842 ± 0.105 ng/m^3 for the agricultural site, and 0.17 ± 0.15 and 0.28 ± 0.54 ng/m^3 for the 2 industrial sites; tetra- and tri- PCBs dominated.
3868428	RefID 3868428 A. E. Sakin, F. Esen, Y. Tasdemir. Effects of sampling interval on the passive air sampling of atmospheric PCBs levels. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering. 2017. 52:673-679 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3868428				✓				Supplemental	Non-US data, but multiple congeners measured	--	19 passive air samples collected in 2013/2014 from Uludag University, Bursa, Turkey; high volume samples also collected; analyzed for 87 PCB congeners; annual concentration of PCBs in air = 0.234 ± 0.175 ng/m^3; seasonal averages were 0.232, 0.246, 0.303, and 0.093 for winter (n=4), spring (n=7), summer (n=5), and fall (n=3), respectively; congeners with 3 or 4 chlorines dominated.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
3872756	RefID 3872756 Q. Li, Y. Wang, C. Luo, J. Li, G. Zhang. Characteristics and potential sources of polychlorinated biphenyl pollution in a suburban area of Guangzhou, southern China. Atmospheric Environment. 2017. 156:70-76 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3872756				✓				Supplemental	Non-US data, but multiple congeners measured	--	Collected 52 vapor and gas phase air samples from a suburban field in Guangzhou, China in 2012; analyzed for 30 PCB congeners; total PCB concentrations ranged from 0.0974 to 0.853 ng/m^3 (geometric mean gas phase = 0.197 and geometric mean particle phase = 0.0213 ng/m^3); tetra-PCBs were major components.
4165825	RefID 4165825 U. Ali, A. J. Sweetman, K. C. Jones, R. N. Malik. Higher atmospheric levels and contribution of black carbon in soil-air partitioning of organochlorines in Lesser Himalaya. Chemosphere. 2018. 191:787-798 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/4165825				✓				Supplemental	Non-US data, but multiple congeners measured	--	Collected air samples in 2016/2017 from 4 zones in the Himalayas (Pakistan) based on influence from anthropogenic sources; analyzed for 36 PCB congeners; concentrations of sum of PCBs ranged from 0.00849 to 0.458 ng/m^3 (mean = 0.133 ± 0.122 ng/m^3); tetra and penta homologue groups dominated (3 highest contributing congeners were 52, 74, and 18).
5017019	RefID 5017019 K. S. Tomsho, K. Basra, S. M. Rubin, C. B. Miller, R. Juang, S. Broude, A. Martinez, K. C. Hornbuckle, W. Heiger-Bernays, M. K. Scammell. Correction to: Community reporting of ambient air polychlorinated biphenyl concentrations near a Superfund site. Environmental Science and Pollution Research. 2018. 25:16401 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017019				✓			No		No new data on PCBs in air	Applicability and Utility	Notification of a correction to the authors' names on the Tomsho et al. 2018 paper.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
5017115	RefID 5017115 A. Martinez, B. Hadnott, A. Awad, N. Herkert, K. Tomsho, K. Basra, M. Scammell, W. Heiger-Bernays, K. Hornbuckle. Continuous release of PCBs from New Bedford Harbor results in elevated concentrations in the surrounding air. Abstracts of Papers - American Chemical Society. 2017. 253:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017115				✓			No		Abstract only	Evaluation and Review	Abstract only; measured airborne PCBs at 18 locations near new Bedford Harbor, MA in 2015, ranging from 0.4 to 38 ng/m^3.
5017566	RefID 5017566 N. Herkert, A. Martinez, K. Hornbuckle. Spatial and temporal variations of PCBs and OH-PCBs in the Metropolitan Chicago area using passive air sampling. Abstracts of Papers - American Chemical Society. 2015. 250:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017566				✓			No		Abstract only	Evaluation and Review	Abstract only; sampled outdoor air (n=230) in Chicago in 2012-2014; "PCB concentrations ranging from 26 to 6200 pg/m^3 with an average of 540 890 pg/m^3."
1058023	RefID 1058023 C. M. Cooney. Detecting a new PCB in Chicago air. Environmental Science and Technology. 2009. 43:4-4 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1058023				✓			No		No new data on PCBs in air	Applicability and Utility	News article about a previously undetected PCB congener found in Chicago air; no information on total PCBs in air.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
1255785	RefID 1255785 A. P. Sharma, B. D. Tripathi. Assessment of total suspended particulate matter-bound polychlorinated biphenyls in ambient air of a seasonally dry tropical urban-industrial area. Ambio. 2009. 38:175-176 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/1255785				✓			No		Synopsis only	Evaluation and Review	Synopsis (not peer reviewed) of study in India in 2005; ambient air samples collected and total suspended particulate (TSP) analyzed for 6 indicator PCBs (28, 52, 101, 138, 153, 180); total PCBs in TSP ranged from <0.00003 to 0.093 ng/m^3 (mean = 0.039 ng/m^3); urban concentrations higher than rural concentrations; winter higher than summer; penta- and hexa-chlorinated congeners dominated.
2336703	RefID 2336703 H. Wei, A. Li. Semi-volatile Organic Pollutants in the Gaseous and Particulate Phases in Urban Air. #journal#. 2010. #volume#:339-362 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2336703				✓			No		No new data on PCBs in air	Applicability and Utility	General information about SVOCs in the environment; review of literature on PCB levels in ambient air.
5017347	RefID 5017347 P. A. Brunciak, C. L. Lavorgna, E. D. Nelson, J. Dachs, S. J. Eisenreich. Trends and dynamics of persistent organic pollutants in the coastal atmosphere of the mid-Atlantic States. Abstracts of Papers - American Chemical Society. 1999. 217:U715-U715 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017347				✓				Already in Tool	Abstract only; cited in Tool but data not used in calculations	Evaluation and Review	Abstract only.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2149545	RefID 2149545 E. Papadopoulou, I. H. Caspersen, H. E. Kvalem, H. K. Knutsen, T. Duarte-Salles, J. Alexander, H. M. Meltzer, M. Kogevinas, A. L. Brantsæter, M. Haugen. Maternal dietary intake of dioxins and polychlorinated biphenyls and birth size in the Norwegian Mother and Child Cohort Study (MoBa). Environment International. 2013. 60:209-216 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149545					✓		No		Non-US population; limited number of congeners analyzed	Applicability and Utility	Estimated dietary intake of 6 non-dioxin like and 12 dioxin-like PCBs among pregnant women in Norway; fish and shellfish constituted 49% of exposure for non-dioxin like PCBs; median dietary intake of non-dioxin-like PCBs ranged from 0.00218 to 0.00257 µg/kg/day depending on the age of the women.
2149786	RefID 2149786 O. Cimenci, S. Vandevijvere, S. Goscinny, M. A. Van Den Bergh, V. Hanot, C. Vinkx, F. Bolle, J. Van Loco. Dietary exposure of the Belgian adult population to non-dioxin-like PCBs. Food and Chemical Toxicology. 2013. 59:670-679 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2149786					✓		No		Non-US population; limited number of congeners analyzed	Applicability and Utility	Dietary exposure was estimated to average 0.00533 µg/kg-day for the Belgian population based on 6 indicator PCBs; fish ingestion was the highest contributor; non-detects set to zero; based on 2004 data.
2150165	RefID 2150165 J. T. Ashley, J. S. Ward, C. S. Anderson, M. W. Schafer, L. Zaoudeh, R. J. Horwitz, D. J. Velinsky. Children's daily exposure to polychlorinated biphenyls from dietary supplements containing fish oils. Food Additives & Contaminants: Part A: Chemistry, Analysis, Control, Exposure & Risk Assessment.					✓		No		Not total dietary exposure	Applicability and Utility	Analyzed 13 samples of fish oil supplements for PCBs in 2010 and estimated dietary exposure among children who consumed the supplements; mean daily exposures were estimated to be 0.0025 to 0.0503 µg/day (or 0.0001 to 0.0025 µg/kg/day for a 20 kg child - EPA estimate).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	2013. 30:506-514 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150165											
2150401	RefID 2150401 J. de Boer, N. Lammertse, J. Koekkoek, B. van Hattum. PCB and organochlorine pesticide concentrations in eel increase after frying. Chemosphere. 2013. 90:139-142 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150401					✓		No		Not total dietary exposure	Applicability and Utility	Conducted experiments to determine changes in PCB (31 congeners) concentrations in eel due to cooking; found that concentrations increase from frying; total dietary exposure values not provided.
2150771	RefID 2150771 M. Roszko, A. Szterk, K. Szymczyk, B. Waszkiewicz-Robak. PAHs, PCBs, PBDEs and Pesticides in Cold-Pressed Vegetable Oils. Journal of the American Oil Chemists' Society. 2012. 89:389-400 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150771					✓		No		Not total dietary exposure	Applicability and Utility	PCBs in oils.
2151098	RefID 2151098 S. H. Romanić, M. M. Sarić, D. Klinčić. Organochlorine contaminants and quality of olive oil collected from olive oil growers along the Croatian Adriatic coast. Bulletin of Environmental Contamination and Toxicology. 2011. 87:574-579 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151098					✓		No		Not total dietary exposure	Applicability and Utility	PCBs in olive oil.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2151302	RefID 2151302 G. Matsadiq, H. L. Hu, H. B. Ren, Y. W. Zhou, L. Liu, J. Cheng. Quantification of multi-residue levels in peach juices, pulps and peels using dispersive liquid-liquid microextraction based on floating organic droplet coupled with gas chromatography-electron capture detection. Journal of Chromatography B, Analytical Technologies in the Biomedical and Life Sciences. 2011. 879:2113-2118 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151302					✓		No		Not total dietary exposure	Applicability and Utility	Levels of PCBs in peaches.
2151331	RefID 2151331 A. A. Adenugba, J. Headley, D. Mcmartin, A. J. Beck. Comparison of levels of polychlorinated biphenyls in edible oils and oil-based products - possible link to environmental factors. Journal of Environmental Science and Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes. 2008. 43:422-428 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151331					✓		No		Not total dietary exposure	Applicability and Utility	PCBs in oils.
2151338	RefID 2151338 M. Gasull, M. Bosch de Basea, E. Puigdomènech, J. Pumarega, M. Porta. Empirical analyses of the influence of diet on human concentrations of					✓		No		Not total dietary exposure	Applicability and Utility	Review of literature to evaluate the influence of diet on human concentrations of PCBs and other POPs.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	persistent organic pollutants: a systematic review of all studies conducted in Spain. Environment International. 2011. 37:1226-1235 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151338											
2152465	RefID 2152465 N. Arnich, A. Tard, J. C. Leblanc, B. Le Bizec, J. F. Narbonne, R. Maximilien. Dietary intake of non-dioxin-like PCBs (NDL-PCBs) in France, impact of maximum levels in some foodstuffs. Regulatory Toxicology and Pharmacology. 2009. 54:287-293 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2152465					✓		No		Non-US population; limited number of congeners analyzed	Applicability and Utility	Dietary exposure estimated for the French population using 2002-2006 data for PCBs in foods and 1998-1999 food consumption data; sum of 6 non-dioxin-like PCBs; mean = 0.0076, 0.0077, and 0.0129 for µg/kg/day for women of child-bearing age, adults, and children, respectively; intake of fish products was a main contributor to total exposure.
2153897	RefID 2153897 C. Bergkvist, M. Berglund, A. Wolk, A. Akesson. DIETARY EXPOSURE TO POLYCHLORINATED BIPHENYLS AND RISK OF MYOCARDIAL INFARCTION IN WOMEN - A POPULATION-BASED PROSPECTIVE COHORT STUDY. American Journal of Epidemiology. 2013. 177:S158-S158 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153897					✓		No		Abstract only; no data provided	Applicability and Utility	Conference abstract only; investigated association between dietary exposure to PCB 153, determined through questionnaire, and myocardial infarction.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2153899	RefID 2153899 C. Bergkvist, M. Berglund, A. Glynn, A. Wolk, A. Akesson. Dietary exposure to PCBs and risk of myocardial infarction in women. Toxicology Letters. 2012. 211:S215-S216 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2153899					✓		No		Abstract only; no data provided	Applicability and Utility	Conference abstract only; investigated association between dietary exposure to PCB 153, determined through questionnaire, and myocardial infarction.
2154249	RefID 2154249 S. Biljana. Assessment of the Serbian population exposure to polychlorinated biphenyls by crops. Environmental Toxicology and Pharmacology. 2008. 25:171-175 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2154249					✓		No		Non-US population; limited number of congeners analyzed	Applicability and Utility	Estimated dietary intake of PCBs in Serbian population from ingestion of whole grain wheat flour, sunflower oil, white sugar, bran, dried sugar beet, and molasses); analyzed for 6 indicator PCBs in 35 food samples in 2002; half detection limit used for non-detects when calculating mean; whole grain wheat flour largest contributor (0.00235 µg/kg/day) to total intake; total intake estimated to be about 0.00287 µg/kg/day.
2154318	RefID 2154318 A. Koizumi, K. H. Harada, B. Eslami, Y. Fujimine, N. Hachiya, I. Hirosawa, K. Inoue, S. Inoue, S. Koda, Y. Kusaka, K. Murata, K. Omae, N. Saito, S. Shimbo, K. Takenaka, T. Takeshita, H. Todoriki, Y. Wada, T. Watanabe, M. Ikeda. Paradoxical increases in serum levels of highly chlorinated PCBs in aged women in clear contrast to robust decreases in dietary intakes from 1980 to 2003 in Japan. Environmental Health and Preventive Medicine. 2009. 14:235-246 https://heronet.epa.gov/heronet/					✓		No		Non-US population; limited number of congeners analyzed	Applicability and Utility	Analyzed stored food samples from 1980 (n=40), 1995 (n=40), and 2003 (n=80) for 13 PCB congeners most predominant in the environment to evaluate trends in dietary intake among Japanese women; geometric mean total PCB intake (µg/g) estimated to be 0.523 (range = 0.105-3.412) in 1980, 0.166 (range = 0.0057-1.548) in 1995, and 0.063 (range = 0.0055-1.102) in 2003; assuming a 60 kg woman, the geometric mean dietary intake would be about 0.001 ug/kg/day in 2003 (EPA estimate).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	index.cfm/reference/download/reference_id/2154318											
2156095	RefID 2156095 E. Fattore, R. Fanelli, E. Dellatte, A. Turrini, A. di Domenico. Assessment of the dietary exposure to non-dioxin-like PCBs of the Italian general population. Chemosphere. 2008. 73:S278-S283 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2156095					✓		No		Non-US population; limited number of congeners analyzed	Applicability and Utility	Dietary intake of PCBs was estimated for the Italian population based on a 1994-1996 food consumption survey and concentrations of 6 PCB congeners in food (after 1997) from various European countries; data for which most of congeners below the LOQ were excluded and data for which some congeners were below LOQ were reported as upper bound value; mean dietary intake of PCBs was 0.0246, 0.0161, and 0.0109 µg/kg-day for toddlers (0.5–6 years old, excluding breastfeeding), children (7–12 year old), and adults (13–94 years old), respectively.
2156336	RefID 2156336 S. Voorspoels, A. Covaci, H. Neels. Dietary PCB intake in Belgium. Environmental Toxicology and Pharmacology. 2008. 25:179-182 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2156336					✓			Supplemental	Non-US population; multiple congeners analyzed	--	Estimated dietary intake of total of 23 PCB congeners for the Belgian population using data of PCBs in foods from 2005 and food intake data; fish had the highest overall PCB concentrations; dietary intake of PCBs ranged from 400 to 540 ng/day (this would be equivalent to about 0.006 to 0.008 µg/kg/day for a 70 kg adult based on EPA calculation).
2345923	RefID 2345923 M. Hulin, N. Bemrah, A. Nougadère, J. L. Volatier, V. Sirot, J. C. Leblanc. Assessment of infant exposure to food chemicals: the French Total Diet Study design. Food Additives & Contaminants: Part A: Chemistry, Analysis, Control, Exposure & Risk Assessment. 2014. 31:1226-1239 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2345923					✓		No		No data on total dietary exposure	Applicability and Utility	Describes the design of the French Total Diet Study for infants.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
2920327	RefID 2920327 L. L. Aylward, J. J. Collins, K. M. Bodner, M. Wilken, C. M. Bodnar. "Intrinsic" elimination rate and dietary intake estimates for selected indicator PCBs: toxicokinetic modeling using serial sampling data in US subjects, 2005-2010. Chemosphere. 2014. 110:48-52 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920327					✓		No		Limited number of congeners analyzed	Applicability and Utility	Reconstructed dietary intake levels of 5 indicator PCB congeners using a PBPK model based on levels of PCBs measured in 2004/2005 and 2010 in serum of 43 workers previously employed in the chemical industry in Midland, MI; median intake estimates for PCBs 105, 118, 138, 153, and 180 were 0.1, 0.07, 0.8, 0.7, and 2.9 ng/kg/d, respectively (0.0001, 0.00007, 0.0008, 0.0007, 0.0029 µg/kg/day).
2932429	RefID 2932429 K. Vin, A. Papadopoulos, F. Cubadda, F. Aureli, H. I. O. Basegmez, M. D'Amato, S. De Coster, L. D'Evoli, M. T. Lopez Esteban, M. Jurkovic, M. Lucarini, H. Ozer, P. M. Fernandez San Juan, I. Sioen, D. Sokolic, A. Turrini, V. Sirot. TDS exposure project: Relevance of the Total Diet Study approach for different groups of substances. Food and Chemical Toxicology. 2014. 73:21-34 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2932429					✓		No		No data on total dietary exposure	Applicability and Utility	Evaluated the relevance of the total diet study for different types of substance; no dietary data for PCBs provided.
2935704	RefID 2935704 J. Lee, H. Lee, D. Kim, M. Yon, J. Nam, S. Kwon, A. Choi, Y. S. Chang, E. Shin, O. Baek, J. Suh, S. Park, C. Kim. Total dietary exposure of PCBs in Koreans and related socio-demographic factors. FASEB Journal. 2014.					✓		No		Abstract only	Evaluation and Review	Abstract only; estimated total dietary exposure to PCBs in Korean population; used Korean total diet study 2008-2100; mean total dietary intake for Korean population = 0.006 µg/kg/day.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	28:#pages# https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2935704											
2939861	RefID 2939861 D. Mihats, W. Moche, M. Prean, E. Rauscher-Gabernig. Dietary exposure to non-dioxin-like PCBs of different population groups in Austria. Chemosphere. 2015. 126:53-59 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2939861					✓		No		Limited number of congeners analyzed	Applicability and Utility	Dietary intake of PCBs was estimated for the Austrian population based on PCBs in 157 food samples collected in 2006-2011 and food consumption data for 2008; sum of 6 indicator PCB congeners (28, 52, 101, 118, 153, 138, 180); mean dietary intake was 0.00337 µg/kg/day for children, 000319 µg/kg/day for women, and 0.00264 µg/kg/day for men; milk and dairy products followed by fish and fish products were the major contributors to total intake.
2944683	RefID 2944683 Y. Akhandaf, J. Van Klaveren, S. De Henauw, G. Van Donkersgoed, T. Van Gorcum, A. Papadopoulos, V. Sirot, M. Kennedy, H. Pinchen, J. Ruprich, I. Rehurkova, G. Perello, I. Sioen. Exposure assessment within a Total Diet Study: A comparison of the use of the pan-European classification system FoodEx-1 with national food classification systems. Food and Chemical Toxicology. 2015. 78:221-229 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2944683					✓		No		No data on total dietary exposure	Applicability and Utility	Discussion of food classification systems used to link food consumption data to contaminant data. No data on total dietary intake.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
5016833	RefID 5016833 L. Marushka, M. Batal, T. Sadik, H. Schwartz, A. Ing, K. Fediuk, C. Tikhonov, H. M. Chan. Seafood consumption patterns, their nutritional benefits and associated sociodemographic and lifestyle factors among First Nations in British Columbia, Canada. Public Health Nutrition. 2018. 21:3223-3236 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5016833					✓		No		No information on congeners analyzed; not total dietary exposure	Clarity and Completeness	Estimated dietary intake of PCBs from ingestion of fish among First Nation British Columbia population; seafood consumption rates were based on data from 2008-2009 for 1,103 participants who provided information based on 24-hour recall; fish samples were collected in 2008 and analyzed for PCBs; no information on the congeners analyzed; mean PCB intake was 0.0003 µg/kg-day for males and 0.00021 µg/kg-day for females.
5016858	RefID 5016858 H. Moon, D. H. Kim, J. E. Oh. Dietary exposure to PCBs by seafood cooking method: A Korean study. Chemosphere. 2019. 215:775-782 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5016858					✓		No		Not total dietary exposure	Applicability and Utility	Samples of 86 different kinds of seafood (n=237; 24 species of fish and 27 species of invertebrates) were collected from Korean grocery stores in 2014/2015; analyzed for 82 PCB congeners; snow crab had the highest PCB concentration overall, but salmon had the highest concentration in the fish category; also analyzed raw and cooked samples to identify differences in PCB concentrations based on 7 different cooking methods; concentration changes based on cooking varied widely, but the overall average was negative; dietary exposure from seafood estimated to be 0.00107 µg/kg/day for cooked seafood and 0.00126 µg/kg/day for raw seafood.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
5016859	RefID 5016859 T. Traoré, A. Forhan, V. Sirot, M. Kadawathagedara, B. Heude, M. Hulin, B. de Lauzon-Guillain, J. Botton, M. A. Charles, A. Crépet. To which mixtures are French pregnant women mainly exposed? A combination of the second French total diet study with the EDEN and ELFE cohort studies. Food and Chemical Toxicology. 2018. 111:310-328 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5016859					✓		No		No data on total dietary exposure	Clarity and Completeness	Identified clusters of mixtures to which pregnant French women are exposed; based on 441 substances in 221 core foods analyzed in French Total Diet Study in 2007 and 2009 and dietary intake data collected in 2003, 2006, and 2011; foods analyzed for 12 dioxin-like congeners and 6 indicator PCBs; mixtures were identified using "non-negative matrix factorisation"; provided percent contribution of various chemicals to mixture; did not provide total dietary intake of PCBs in µg/kg/day.
5016868	RefID 5016868 J. Ravenscroft, L. M. Schell, Akwesasne Task Force on the Environment. Patterns of PCB exposure among Akwesasne adolescents: The role of dietary and inhalation pathways. Environment International. 2018. 121:963-972 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5016868					✓		No		No data on total dietary exposure	Clarity and Completeness	Evaluated dietary patterns in association with serum PCB concentrations in 246 Mohawk adolescents in 1999-2000; used a semi quantitative food frequency questionnaire and serum concentrations of 101 PCB congeners; multivariate regression used to identify relationships between dietary patterns and serum levels of PCBs; fish and dairy were predictors of one or more PCB congener profiles; no data were provided on total dietary intake in µg/kg/day.

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
5016874	RefID 5016874 H. A. Lee, H. J. Hwang, S. Y. Oh, E. H. Ha, H. Park. Dietary patterns related to exposure to persistent organic pollutants based on the Ewha Birth and Growth Cohort. Environmental Pollution. 2018. 243:189-196 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5016874					✓		No		No data on total dietary exposure	Clarity and Completeness	Evaluated dietary patterns in association with serum PCB concentrations in 188 Korean children in 2001; used a semi-quantitative food frequency questionnaire and serum concentrations of 32 PCB congeners; regression analyses were used to identify relationships between dietary patterns and serum PCB levels; intake of shellfish/salted seafood, cheese, nuts, and seeds were associated with PCB concentrations in serum; no data were provided on total dietary intake in µg/kg/day.
5017015	RefID 5017015 S. W. C. Chung, J. S. Y. Lau, J. Y. K. Chu. Dietary exposure to non-dioxin-like PCBs of the Hong Kong adult population from a total diet study. Food Additives & Contaminants: Part A: Chemistry, Analysis, Control, Exposure & Risk Assessment. 2018. 35:519-528 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5017015					✓		No		Limited number of congeners analyzed	Applicability and Utility	Dietary exposure estimated for the population of Hong Kong; used food consumption data from 2005-2007 and data on the concentration of 6 indicator PCBs in 71 foods from Hong Kong's 2010-2011 Total Diet Study; range for average adult consumer (mean intake) = 0.00068 to 0.00138 µg/kg/day; high-end adult consumer (95th percentile intake) = 0.00308 to 0.00384 µg/kg/day; lower bound values based on non-detects set equal to zero and upper bound values based on non-detects set to LOD; main dietary source of PCBs was fish and seafood; salmon had the highest mean PCB concentration.
729962	RefID 729962 A. Schecter, J. Colacino, D. Haffner, K. Patel, M. Opel, O. Päpke, L. Birnbaum. Perfluorinated compounds, polychlorinated biphenyls, and organochlorine pesticide contamination in composite food samples from Dallas, Texas, USA. Environmental Health Perspectives. 2010. 118:796-802 https://heronet.epa.gov/heronet/					✓		No		Limited number of congeners analyzed	Applicability and Utility	Analyzed 310 samples of 31 different types of foods in Texas for 7 PCB congeners; and estimated dietary exposure; all PCB congeners found in salmon and sardines; PCB 153 and 180 found in hamburger; PCB 180 found in ice cream and peanut butter; total dietary intake estimated to be 33 ng/day (about 0.0005 µg/kg day for a 70 kg adult).

RefID	HERO ID and Citation	Dust	Soil	Indoor Air	Outdoor Air	Dietary	Include?			Why or why not included?	Primary GAF if 'No'	Summary
							Yes	No	Other			
	index.cfm/reference/download/reference_id/729962											
2162593	RefID 2162593 P. Fuerst. Dioxins and PCBs in the food chain - a never-ending story?. Journal of Veterinary Pharmacology and Therapeutics. 2012. 35:34-34 https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2162593					✓		No		Abstract only; no data provided	Evaluation and Review	Conference abstract only; overview of dietary exposure; no data.
TOTAL	**232**	**26**	**103**	**31**	**76**	**32**	**8**	**168**	**61**			

NOTE: Underlining in Summary column emphasizes the results for studies included in Appendix E, or reasons for exclusion.

APPENDIX E – Media-specific Summaries of Studies Used to Update the Tool, and Those Providing Supplemental Information

Table E-1. DUST SUMMARY								
Ref ID	**Study**	**Include?**	**Location**	**Site**	**N**	**Congeners**	**Results**	
							Central	**Range**
2187227	Vorhees et al., 1999	Yes	Massachusetts	reference homes	15	65	geo mean = 0.69 µg/g dw	0.26 - 3.6 µg/g dw
198203	Hwang et al., 2008	Yes	California	10 apartments; 1 community hall	11	54	mean = 0.075 µg/g	<0.01 - 0.57 µg/g
5016984	Arnold et al., 2018	Yes	Indiana Portugal	3 senior facilities 11 senior facilities	14 28	82	geo mean ± SE = 0.092 ± 0.05 µg/g geo mean ± SE = 0.098 ± 0.038 µg/g	0.024 - 0.750 µg/g 0.0025 - 0.690 µg/g
198193	Harrad et al., 2009	Already in Tool	Texas UK Canada New Zealand	homes homes homes homes	20 20 10 20	congeners with 3-7 chlorines	mean = 0.22 µg/g mean = 0.11 µg/g mean = 0.29 µg/g mean = 0.067 µg/g	0.047 - 0.62 µg/g 0.0057 - 0.86 µg/g 0.056 - 0.82 µg/g 0.011 - 0.26 µg/g
198241	Takigami et al., 2009	Supplemental	Japan	homes	2	mono-deca congeners	0.015 and 0.022 µg/g	--
1927567	Tue et al., 2013	Supplemental	Viet Nam	houses	6 urban 7 suburban	62	median = 0.01 µg/g median = 0.0054 µg/g	0.0056 - 0.085 µg/g 0.0036 - 0.02 µg/g
198523	Tan et al., 2007	Supplemental	Singapore	homes	31	41	mean = 0.0092 µg/g	<LOD - 0.044 µg/g
2149869	Wang et al., 2013	Supplemental	China (2 cities)	homes	40	37	means = 0.0818 and 0.139 µg/g	0.0174 - 0.264 µg/g
2533249	Wang et al., 2015	Supplemental	China	urban houses	114	39	mean = 0.11 µg/g	0.01 - 0.667 µg/g
Number of Studies		**9 Total: 3 Yes, 1 Already in Tool, 5 Supplemental**						
AVERAGE YES AND ALREADY IN TOOL (US only) (µg/g)							**0.27**	**<0.01 - 3.6**
AVERAGE ALL (µg/g)							**0.13**	**<LOD - 3.6**
Value in Current PCB Exposure Estimation Tool (µg/g)							**0.22**	

Table E-2. SOIL SUMMARY								
Ref ID	Study	Include?	Location	Site	N	Congeners	Results	
							Central	Range
2187227	Vorhees et al., 1999	Yes	Massachusetts	reference homes	16	65	geometric mean = 0.06 µg/g dw	0.015 - 0.29 µg/g dw
2150856[a]	Martinez et al., 2012	Yes	Iowa	residential	64	164	mean ± SD = 0.056 ± 0.160 µg/g dw	0.003 - 1.2 µg/g dw
198230	Priha et al., 2005	Already in Tool	Finland	parks	--	--	0.025 (Tampere); 0.053 µg/g (Helsinki)	--
198165	Batterman et al., 2009	Supplemental	South Africa	residential, agricultural	3 sites	82	mean ± SD = 0.110 ± 0.116 ug/g	--
198253	Zhang et al., 2008	Supplemental	China	urban, rural, background	51	60	mean = 0.000488 ug/g	0.000138 - 0.00184 µg/g
2149390	Yolsal et al., 2014	Supplemental	Turkey	urban coastal	51	82	mean ± SD = 0.00201 ± 0.001735 µg/g dw mean ± SD = 0.000535 ± 0.00051 µg/g dw	0.000105 - 0.00706 µg/g 0.00011 - 0.00232 µg/g
2155065	Fu et al., 2009	Supplemental	China	urban	15	144	median = 0.00064 µg/g dw	0.000051 to 0.0047 µg/g dw
2929235	Mamontova et al., 2014	Supplemental	Russia	residential, recreational, industrial	21	37	mean = 0.012 µg/g dw	0.0012 - 0.050 µg/g dw
3986271	Mamontova et al., 2016	Supplemental	Russia	residential, recreational, industrial	47	37	mean = 0.0768 µg/g	0.00725 - 0.46 µg/g
1927642	Ilyas et al., 2011	Supplemental	Indonesia	industrial roads, urban roads, municipal dump sites, rural roads, agricultural	23	62	median = 0.0012 µg/g dw	non-detect - 0.0096 µg/g dw
198247	Wang et al., 2008	Supplemental	China	urban business/residence, industrial, garden, rural	14	84	mean = 0.0028 µg/g dw	0.0013 - 0.0048 µg/g dw
198653	Gao et al., 2006	Supplemental	China	paddy, upland, forest, wasteland	131	Aroclors 1221, 1242, and 1254	mean ± SD = 0.0454 ± 0.0406 µg/g dw	0.0075 - 0.263 µg/g dw
2149606	Mamontova et al., 2013	Supplemental	Mongolia	urban, rural, background	61	37	mean = 0.0074 µg/g dw	0.00053 - 0.114 µg/g dw
2149634	Salihoglu et al., 2013	Supplemental	Turkey	urban, rural, industrial	43	83	spring mean ± SD = 0.001275 ± 0.001120 µg/g dw summer mean ± SD = 0.004075±0.002740 µg/g dw fall mean ± SD = 0.002185 ± 0.002010 µg/g dw winter mean ± SD = 0.001150 ± 0.001540 µg/g dw	-- -- -- --
2149906	Kumar et al., 2013	Supplemental	India	urban	13	28	mean = 0.01157 µg/g	0.00333 - 0.03481 µg/g
2151038	Li et al., 2011	Supplemental	China	urban, suburban, rural	82	84	mean = 0.004 µg/g dw	0.00036 - 0.01688 µg/g dw
2151076	Schuster et al., 2011	Supplemental	Norway, United Kingdom	background	70	31	mean = 0.00645 ± 0.00545 µg/g	0.00021 - 0.0271 µg/g

Table E-2. SOIL SUMMARY								
Ref ID	Study	Include?	Location	Site	N	Congeners	Results	
							Central	Range
2151693	Jiang et al., 2011	Supplemental	China	roadsides, greenbelts, parks, residential, commercial	55	144	mean = 0.003057 µg/g	0.000232 - 0.011 µg/g
2152319	Salihoglu et al., 2011	Supplemental	Turkey	remote to heavy industrial	43	83	0.002122 µg/g dw	0.000208 - 0.005462 µg/g
2154719	Ma et al., 2009	Supplemental	China	urban, suburban, rural, background	17	44	mean = 0.00163 µg/g	0.0003 - 0.00617 µg/g dw
2155561	Fu et al., 2008	Supplemental	China	urban industrial	10	144	median = 0.001 µg/g median = 0.0024 µg/g	0.0002 - 0.0034 µg/g dw 0.0005 - 0.0148 µg/g dw
2157320	Ren et al., 2007	Supplemental	China	background, rural, urban	52	84	mean = 0.000515 µg/g dw	0.000138 - 0.00184 µg/g
2158048	Heywood et al., 2006	Supplemental	Great Britain	rural	15	33	mean ± SD = 0.005028 ± 0.008411 µg/g dw	0.000274-0.080579 µg/g
2159888	Wilcke et al., 2006	Supplemental	Russia	grassland and forest	23	33	--	0.0055 - 0.079 µg/g
2163561	Meijer et al., 2003	Supplemental	worldwide	remote from potential sources	191	29 (tri- through octa- PCBs)	mean = 0.00541 µg/g dw	0.000026 - 0.0966 µg/g dw
2186307	Tremolada et al., 2008	Supplemental	Peru Italy	mountain	29	30 (tri- through octa- PCBs)	mean = 0.00008 µg/g dw mean = 0.0036 µg/g dw	<0.00001 - 0.00044 µg/g dw 0.00061 - 0.0089 µg/g dw
2188472	Wu et al., 2010	Supplemental	China	rural	--	di- through hepta PCBs	mean = 0.01101 µg/g	0.0026 - 0.01956 µg/g
2920186	Zheng et al., 2014	Supplemental	China	forest	159	29	mean = 0.00051 µg/g	0.000057 - 0.00132 µg/g
2924494	Perez-Maldonado., 2014	Supplemental	Mexico	reference site	29	40	mean ± SD = 0.0686 ± 0.0545 µg/g	0.0062 - 0.1867 µg/g
2944597	Vane et al., 2014	Supplemental	United Kingdom	urban and semi-urban	76	tri- to hepta-homologues	mean = 0.123 µg/g	0.009 - 2.642 µg/g
3985243	Kim et al., 2017	Supplemental	Korea	industrialized	30	29	--	0.000216 - 0.001824 µg/g
3985264	Kim et al., 2016	Supplemental	Korea	agricultural	5	29	--	0.000107-0.000223 µg/g
5017634	Devi et al., 2018	Supplemental	India	mountain	60	25	median = 0.00578 µg/g dw	0.00159 - 0.0217 µg/g dw
587465	Tang et al., 2010	Supplemental	China	reference site	1	58	0.0249 µg/g	--
Number of Studies		**34 Total: 2 Yes, 1 Already in Tool, 31 Supplemental**						
AVERAGE YES (US only) (µg/g)							**0.06**	**0.003 - 1.2**
AVERAGE ALL (µg/g)							**0.02**	**<0.00001 - 2.642**
Value in Current PCB Exposure Estimation Tool (µg/g)							**0.05**	

[a] Also found in targeted internet search.

Table E-3. INDOOR AIR SUMMARY								
Ref ID	**Study**	**Include?**	**Location**	**Site**	**N**	**Congeners**	**Results**	
							Central	**Range**
292007[a]	Ampleman et al., 2015	Yes	Indiana Iowa Indiana Iowa	homes homes schools schools	34 35 13 11	201	geo mean ± SE = 1.0 ± 0.02 ng/m^3 geo mean ± SE = 0.44 ± 0.1 ng/m^3 geo mean ± SE = 6.4 ± 0.1 ng/m^3 geo mean ± SE = 8.4 ± 0.4 ng/m^3	-- -- -- --
3984192[a]	Marek et al., 2017	Yes	Indiana, Iowa	schools	4 urban, 2 rural	209	--	0.5 - 194 ng/m^3
2151223[a]	Fitzgerald et al., 2011	Yes	New York	homes in study and reference areas	176	84	mean = 14 ng/m^3	0.6 - 233 ng/m^3
*	Vorhees et al., 1997	Yes	Massachusetts	comparison homes	16	65	geometric mean = 10 ng/m^3	5.2 - 51 ng/m^3
198193	Harrad et al., 2009	Already in Tool	Canada	homes	10	congeners with 3-7 chlorines	mean = 6.9 ng/m^3	1.1 - 14.4 ng/m^3
198177	Currado & Harrad, 1998	Already in Tool	England	laboratories, offices, homes	14	tr- through hepta-chlorinated	mean = 9 ng/m^3	1.1 - 69 ng/m^3
198241	Takigami et al., 2009	Supplemental	Japan	homes	4	mono- through deca chlorinated	--	0.73-1.5 ng/m^3
198222	Menichini et al., 2007	Supplemental	Italy	homes	3	62	--	6.5 - 33 ng/m^3
2154635	Bohlin et al., 2008	Supplemental	Mexico, urban Mexico, semi-urban Sweden UK	homes homes homes homes	35	43	mean = 0.47 ng/m^3 mean = 0.19 ng/m^3 mean = 0.89 ng/m^3 mean = 0.86 ng/m^3	0.21 - 0.84 ng/m^3 0.1 - 0.32 ng/m^3 0.33 - 1.6 ng/m^3 0.15 - 2.1 ng/m^3
198192	Harrad et al., 2006	Supplemental	England	homes offices public microenvironments	31 33 3	total PCBs = 5 x sum of 6 congeners	mean = 2.8 ng/m^3 mean = 18.1 ng/m^3 mean = 30.7 ng/m^3	0.487 - 9.764 ng/m^3 0.816 - 101.8 ng/m^3 1.08 - 81.5 ng/m^3
1082281	Zhang et al., 2011	Supplemental	Canada	homes, offices, laboratories	20	total PCBs = 5 x sum of 6 congeners	geometric mean = 6.5 ng/m^3	0.8 - 130.5 ng/m^3
2150587[a]	Frederiksen et al., 2012	Supplemental	Denmark	apartments	20	total PCBs = 5 x sum of 6 congeners	mean = 6.03 ng/m^3	<LOQ - 30.6 ng/m^3
Number of Studies		**12 Total: 4 Yes, 2 Already in Tool, 6 Supplemental**						
AVERAGE YES (US only) (ng/m^3)							**6.7**	**0.5 - 233**
AVERAGE ALL (ng/m^3)							**7.2**	**<LOQ - 233**
Value in Current PCB Exposure Estimation Tool (ng/m^3)							**6.9**	

* Reference identified in targeted internet search conducted in November 2018

[a] Also found in targeted internet search.

Table E-4. OUTDOOR AIR SUMMARY								
Ref ID	Study	Include?	Location	Site	N	Congeners	Results	
							Central	Range
3984192[a]	Marek et al., 2017	Yes	Indiana, Iowa	Schools	4 urban, 1 rural	209	median = 0.21 ng/m^3 median = 0.584 ng/m^3 median = 0.183 ng/m^3 median = 0.36 ng/m^3 median = 0.159 ng/m^3	0.03 - 3 ng/m^3
2156999	Yan et al., 2008	Yes	New Jersey	park urban	8 14	90	0.7 ng/m^3 1.2 ng/m^3	0.18 – 1.3 ng/m^3 0.48 – 2.4 ng/m^3
*	Hu et al., 2010	Yes	Illinois	urban (37 sites in Chicago)	184	209	mean = 0.84 ng/m^3	0.075 - 5.5 ng/m^3
*	Palmer et al., 2008	Yes	New York	comparison area	85	84	median = 0.431 ng/m^3	0.080 - 2.366 ng/m^3
**	Vorhees et al., 1997	Yes	Massachusetts	homes	20	65	geometric mean = 0.6 ng/m^3	0.1- 8.2 ng/m^3
198177	Currado and Harrad, 1998	Already in Tool	England	urban	25	tr- through hepta-chlorinated	mean = 0.31 ng/m^3	0.08 - 1.5 ng/m^3
198193	Harrad et al., 2009	Already in Tool	Canada	urban	--	--	mean = 0.51 ng/m^3	0.1 - 1.4 ng/m^3
198241	Takigami et al., 2009	Supplemental	Japan	Homes	2	mono- through deca chlorinated	0.24 ng/m^3 0.73 ng/m^3	--
1082315	Xing et al., 2011	Supplemental	China	residential reference site	2	37	0.46 ng/m^3	--
198165	Batterman et al., 2009	Supplemental	South Africa	urban, industrial, residential	3	82	mean = 0.128 ± 0.047 ng/m^3	maximum = 0.233 ng/m^3
198236	Salihoglu and Tasdemir, 2009	Supplemental	Turkey	urban, suburban, residential, industrial	4	41	--	0.035 - 1.112 ng/m^3
198253	Zhang et al., 2008	Supplemental	China	urban, rural, background	97	60	mean = 0.25 ng/m^3	0.029 - 1.05 ng/m^3
2149390	Yolsal et al., 2014	Supplemental	Turkey	urban coastal	51	82	mean = 0.36 ± 0.21 ng/m^3 mean = 0.465 ± 0.285 ng/m^3	0.1 - 0.9 ng/m^3 0.075 - 1.025 ng/m^3
2929235	Mamontova et al., 2014	Supplemental	Russia	residential, recreational, and industrial zones	21	37	--	2.69 - 13.48 ng/m^3
3986271	Mamontova et al., 2016	Supplemental	Russia	residential, recreational, and industrial zones	3	37	mean = 0.228 ng/m^3	0.015 - 0.745 ng/m^3
198222	Menichini et al., 2007	Supplemental	Italy	homes	3	62	--	1.9 - 5.4 ng/m^3
2154635	Bohlin et al., 2008	Supplemental	Mexico, urban Mexico, semi-urban	homes homes	11	43	mean = 0.44 ng/m^3 mean = 0.15 ng/m^3	0.23 - 0.66 ng/m^3 0.087 - 0.21 ng/m^3

Table E-4. OUTDOOR AIR SUMMARY								
Ref ID	**Study**	**Include?**	**Location**	**Site**	**N**	**Congeners**	**Results**	
							Central	**Range**
			Sweden UK	homes homes			mean = 0.12 ng/m^3 0.12 ng/m^3	0.059 - 0.17 ng/m^3 0.12 ng/m^3
2150915	Hogarh et al., 2012	Supplemental	Japan China Korea	rural, suburban, urban	55 20 30	202	mean = 0.184 ± 0.024 ng/m^3 mean = 1.1 ± 0.118 ng/m^3 mean = 0.156 ± 0.02 ng/m^3	-- '-- '--
2152699	Birgul and Tasdemir, 2011	Supplemental	Turkey	semi-rural	70	83	mean = 0.393 ± 0.278 ng/m^3	--
2158432	Mandalakis et al., 2007	Supplemental	Germany	rural	14	54	mean = 0.11 ± 0.080 ng/m^3	0.036 - 0.374 ng/m^3
2162520	Jaward et al., 2004	Supplemental	22 European countries	remote, rural, urban	71	29	--	0.020 - 1.7 ng/m^3
2184279	Shunthirasingham et al., 2011	Supplemental	Chile	elevation gradients	20	56	--	0.0002 - 0.027 ng/m^3
2696310	Estellano et al., 2014	Supplemental	Italy	urban, suburban	4	28	mean = 0.08 ± 0.05 ng/m^3	0.03 - 0.2 ng/m^3
2920031	Wang et al., 2015	Supplemental	Australia	remote/background, agricultural, semi-urban, urban	15	47	median = 0.0089 ng/m^3	0.00073 - 0.072 ng/m^3
3350696	Sakin and Tasdemir, 2016	Supplemental	Turkey	semi-rural	48	87	mean = 0.293 ± 0.257 ng/m^3	0.00063 - 0.897 ng/m^3
3604873	Birgul et al., 2017	Supplemental	Turkey	rural semi-urban urban agricultural industrial	1 site 2 sites 2 sites 1 site 2 sites	43	mean = 0.024 ± 0.0082 ng/m^3 mean = 0.0438 ± 0.0244; 0.18 ± 0.21 ng/m^3 mean = 0.0429 ± 0.0246; 0.16 ± 0.28 ng/m^3 mean = 0.0842 ± 0.105 ng/m^3 mean = 0.17 ± 0.15; 0.28 ± 0.54 ng/m^3	0.0126 - 0.0355 ng/m^3 0.0156 - 0.08; <MDL - 0.48 ng/m^3 0.0196 - 0.0741; 0.0221 - 0.66 ng/m^3 0.0096 - 0.248 ng/m^3 0.021 - 0.34; 0.0229 - 1.24 ng/m^3
3868428	Sakin et al., 2017	Supplemental	Turkey	university campus	19	87	annual mean = 0.234 ± 0.175 ng/m^3	--
3872756	Li et al., 2017	Supplemental	China	suburban	52	30	geometric mean gas phase = 0.197 ng/m^3	0.0974 - 0.853 ng/m^3
4165825	Ali et al., 2018	Supplemental	Pakistan	urban to remote	8 sites in each of 4 zones	36	mean = 0.133 ± 0.122 ng/m^3	0.00849 - 0.458 ng/m^3
Number of Studies		**29 Total: 5 Yes, 2 Already in Tool, 22 Supplemental**						
AVERAGE YES (US only) (ng/m^3)							**0.53**	**0.03 - 8.2**
AVERAGE ALL (ng/m^3)							**0.32**	**0.0002 - 13.48**
Value in Current PCB Exposure Estimation Tool (ng/m^3)							**0.50**	

* Cited in another paper.

** Reference identified in targeted internet search conducted in November 2018.

[a] Also found in targeted internet search.

Table E-5. DIETARY SUMMARY								
Ref ID	**Study**	**Include?**	**Location**	**Site**	**N**	**Congeners**	**Results**	
							Central	**Range**
2920071[a]	Ampleman et al., 2015	Supplemental	Canada	--	--	40	--	0.006-0.01 µg/kg-day for a 30 kg child; 0.003 µg/kg-day for a 70 kg adult
2156336	Voorspoels et al., 2008	Supplemental	Belgium	--	--	23	--	0.006 to 0.008 µg/kg/day for a 70 kg adult
Number of Studies		**2 Total: 2 Supplemental**						
AVERAGE ALL (µg/kg-day)								**0.003 to 0.01**
Value in Current PCB Exposure Estimation Tool (µg/kg-day)								**0.001 to 0.002 depending on age (see FDA memo)**

[a] Also found in targeted internet search.

APPENDIX F – PCB Exposure Estimation Tool

PCB Exposure Estimation Tool

Version 2.0

Last Modified: June 14, 2019

Tab A Introduction

This tool was developed to help exposure/risk assessors estimate total PCB exposures. It provides exposure estimates for school children (daycare, pre-school, elementary, middle and high school) and school staff including teachers and other school personnel. Total PCB exposures are estimated as the sum of exposures occurring in non-school (background) and school settings. The tool contains a series of 12 worksheets or tabs (including this Tab - Tab A) that guide users through the calculations and provide suggested input values for parameters such as intake rate, exposure duration, body weight, PCB concentration, etc. The suggested input values are generally means or medians and are used to estimate average or "central tendency" exposures. However, these values can be changed, as needed, to address concerns at specific sites or populations in other kinds of buildings. The worksheets provide estimates of background (residential and other environmental) exposures, and exposures from activities taking place in and around schools. The Tool may be also used to calculate the maximum PCB concentration in indoor school to which individuals could be exposed without exceeding the reference dose (RfD) (see Tab E) when all other school and non-school PCB exposure pathways are set to average background levels.
Tab (worksheet) B provides background information on the tool, including the exposure scenarios addressed by the tool and the assumptions used for estimating exposures.
Tab (worksheet) C provides information on how to use this spreadsheet.
Tab (worksheet) D (shaded in orange) provides input values and assumptions for the parameters used in the tool. Any change to the input values in this table will also change values in worksheets E, F, and G. Values in grayed-out cells are locked and cannot be changed. Values in red are those for which site-specific values may be more appropriate and should be changed by the user.
Tab (worksheet) E (shaded in green) shows the total PCB doses from each pathway evaluated (e.g., inhalation of indoor air, ingestion of dust, etc.). The values are derived in Worksheets F and G and cannot be directly changed by the user. Total average daily doses on this tab are compared to the oral Reference Dose (RfD) for Aroclor 1254.[1] The RfD for PCB Aroclor 1254 is the more conservative of the two RfDs that are available for PCB Aroclors in EPA's IRIS database (U.S. EPA, 2019). The IRIS glossary (https://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=IRIS Glossary) defines an RfD as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure for a chronic duration (up to a lifetime) to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." This tab also estimates the maximum PCB concentration (ng/m3) in school indoor air without exceeding the RfD, assuming all other exposure pathways (including background) remain unchanged.
Tab (worksheet) F (shaded in yellow) calculates background doses of PCBs from non-school dust and soil ingestion, inhalation of indoor and outdoor air, dermal absorption, and dietary ingestion (food). Values in grayed-out cells are locked and cannot be changed. Values in red are those for which site-specific values may be more appropriate. Drinking water is not included because according to ATSDR (2000), "drinking water is not considered a significant pathway for exposure."
Tab (worksheet) G (shaded in blue) calculates PCB doses that could occur in schools. Estimates are provided for dust ingestion, soil ingestion, inhalation of indoor school air and surrounding outdoor air, and dermal absorption. Values in grayed-out cells are locked and cannot be changed. Values in red are those for which site-specific values may be more appropriate.
Tab (worksheet) H provides the citations for all references used in this tool.
Tab (worksheet) I provides an alphabetic list of the variables and parameters used in all worksheets in this tool.
Tab (worksheet) J provides a disclosure statement about the review of this tool.
Tab (worksheet) K provides information about changes made to the various versions/updates of this tool.
Tab (worksheet) L (shaded in pink) provides the FDA data on total dietary intake of PCBs.

[1] Aroclors are a PCB mixture manufactured and used from approximately 1930 to 1979. Aroclor 1254 evaluated in this Estimator Tool means that the mixture contains approximately 54% chlorine by weight.

Tab B Background

This tool was developed to help exposure/risk assessors estimate total PCB exposures in two different situations or scenarios. The first "background" scenario is for PCB exposures at non-school (primarily residential) buildings. The second scenario is a contaminated school. The background (non-school) scenario includes exposure estimates for non-dietary ingestion of soils and dusts, inhalation, dermal contact, and dietary (food) ingestion. The contaminated school scenario includes estimates for the same exposure routes except that no estimate for dietary ingestion is included, because the Food and Drug Administration (FDA) dietary estimates used in the non-school scenario represent total dietary exposure. Also, these total dietary estimates represent the general population, and it is assumed that total dietary exposures for students would not differ from those of the general population.
Exposure estimates are expressed as μg/kg-day, except for the summary spreadsheet where values are expressed as ng/kg-day. Daily values represent estimates averaged over an entire year and reflect the actual number of days in school. Suggested default values are provided for the input variables. These values are generally intended to represent central tendency exposures. If appropriate to the location or population of interest, some of these values may be changed. Others, signified by shaded cells, are constants and may not be changed by the user.
Dust and Soil Ingestion: Background (non-school) dust ingestion is estimated by multiplying total daily dust ingestion by the fraction of indoor awake time spent in locations other than schools times the concentration of PCBs in background dust. Background (non-school) soil ingestion is estimated by multiplying total daily soil ingestion by the fraction of outdoor time spent at locations other than schools times the concentration of PCBs in background soil. For the contaminated schools scenario, dust ingestion is estimated by multiplying total daily dust ingestion by the fraction of indoor awake time spent in schools times the concentration of PCBs in school dust. Soil ingestion at schools is estimated by multiplying total daily soil ingestion by the fraction of outdoor time spent at schools times the concentration of PCBs in school soil.
Inhalation: Background (non-school) indoor air inhalation is estimated by multiplying total daily inhalation rates by the fraction of time spent indoors at locations other than schools times the concentration of PCBs in indoor (non-school) air. Background (non-school) outdoor air inhalation is estimated by multiplying total daily inhalation rates by the fraction of time spent outside away from school times the concentration of PCBs in outdoor air. For the contaminated schools scenario, indoor air inhalation is estimated by multiplying total daily inhalation rates by the fraction of time spent indoors at schools times the concentration of PCBs in indoor (school) air. School outdoor air inhalation is estimated by multiplying total daily inhalation rates by the fraction of time spent outside at school times the concentration of PCBs in outdoor air.
Dermal Exposure: For both the background (non-school) and school scenarios, dermal absorption from contact with PCBs in indoor dust is estimated by assuming that dust adheres to exposed skin surfaces and that PCBs are absorbed through the skin. Dermal absorption from direct contact with caulk or other PCB impregnated surfaces (i.e., non-liquid materials such as surfaces with PCB-containing paint) is assumed to be low because of the limited access to these materials (i.e., low contact) and is not included.
Dietary Ingestion: Food and Drug Administration (FDA) estimates of daily doses of PCBs from dietary (food) sources are used for the background (non-school) estimates provided in the spreadsheet. In this version of the PCB Exposure Estimation Tool (Version 2.0) these background estimates are based on FDA's Total Diet Study data for 2003. The original version of the Tool (Version 1.1) used FDA Total Diet Study data from 1997.
For all exposure scenarios, relative absorption factors are used to estimate doses that are comparable to an administered food dose. This is done by first multiplying by the pathway specific absorption fraction, and then dividing by the food ingestion absorption fraction. For the inhalation route this factor is one because the absorption fraction from the food and air are assumed to be the same (about 80%). This procedure puts all doses on a comparable basis to each other and to the published IRIS reference dose.
The total PCB concentrations in environmental media that are used in this Tool to represent background concentrations are based on the sum of PCB congeners analyzed in various studies. It is possible that the mixtures of congeners in these studies may differ from the mix of congeners in a particular school environment and in Aroclor 1254 which is the basis for the RfD used in the Tool.
Estimated PCB doses are compared to the oral reference dose (RfD) for PCB Aroclor 1254 (see https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?&substance_nmbr=389 for the IRIS summary for Aroclor 1254). The reference dose is an estimate of a daily oral exposure to the human population, including sensitive subgroups, that is likely to be without an appreciable risk of deleterious effects during a lifetime. This RfD is the more conservative RfD of those available for PCB Aroclors in EPA's IRIS database (U.S. EPA, 2019).

Tab C How to Use the PCB Exposure Assessment Tool

The PCB Exposure Assessment Tool has been created using Microsoft® Excel software. The Excel spreadsheet provides a simple format for facilitating organization of input data and calculation of tool outputs. Embedded formulae are used for calculating doses, and linkages are used to generate output summaries.

Opening the PCB Exposure Assessment Tool:

The PCB Exposure Assessment Tool is a protected ("read-only") spreadsheet. As such, users will need to open the tool as a "read only" file. Users will be able to view default inputs and outputs, and change certain default input values to provide site-specific values. However, they will not be able to save changes made the spreadsheet unless they give it a new file name. This is to prevent users from inadvertently saving over the default values.

Navigating among Worksheets:

The spreadsheet is comprised of 12 worksheets labeled Tabs A through L. The input tab and calculations tabs are color-coded for easy identification. The following worksheets are included:

Tab A	–	Introduction
Tab B	–	Background
Tab C	–	How-to-use
Tab D (orange)	–	Inputs & Assumptions
Tab E (green)	–	Total Exposures
Tab F (yellow)	–	Background Exposures
Tab G (blue)	–	School Exposures
Tab H	–	References
Tab I	–	Variable List
Tab J	–	Disclosure
Tab K	–	Versions
Tab L	–	FDA Dietary Data

To navigate among the 12 tabs, place the cursor over the tab of the worksheet that you wish to view and click the left mouse button. Use the arrow s at the bottom left hand side of the screen to scroll among the various tabs.

Navigating within a Worksheet:
To navigate within the worksheet, use the up and down arrow keys on your keyboard, or use your mouse to slide the bar at the right side of the screen up or down (or at the bar at the bottom of the screen left or right) by placing the cursor over the bar and moving it in the direction desired.

Changing Default Values:
The worksheets in Tabs D, F and G provide the default input variables and equations for calculating exposures to PCBs in background (non-school) and school settings. If the default inputs values provided in this tool are representative of the conditions at the site being assessed, there is no need to change input values. However, certain input values may be changed by the user, if necessary, to reflect site-specific conditions.
Formulae used in the worksheets are protected (i.e., they cannot be changed by the user) to prevent inadvertent revisions to these functions. Also, some of the input values (e.g., conversion factors) or calculated values are protected and cannot be changed by the user. These variables are denoted by gray shaded cells in the worksheets.
Users may change non-protected data (non-grayed out cells) as follows: place the cursor over the cell with the value to be changed, double click the left mouse button, use the keyboard to type the new value, and hit enter. Alternatively, use the up or down arrow keys to highlight the cell where the value is to be changed, use the delete button on the keyboard to erase the default value, type the new value, and hit enter. It is important that any changes to the default input values reflect the same units of measure as those designated in the worksheets.
There is an "undo" arrow in the toolbar at the top of the screen that may be used, if necessary, to change an entered value back to the previous value. Note that some of the information is linked from one worksheet to another (e.g., dose calculations made on Tabs F and G are summarized on Tab E) and default values are entered on Tab D. Changes made to default input values on Tab D will be reflected in the other relevant worksheets.

Saving your Work:

The PCB Exposure Assessment Tool is a protected ("read-only") spreadsheet. As such, users will not be able to save changes made the spreadsheet unless they give it a new file name. This is to prevent users from inadvertently saving over the default values.
To save your work, click on "File" on the toolbar at the top of the screen. Then click on "Save As." Give the workbook a new name in the "Save as" dialog box. Then click "Save."
Alternately, click on "File" in the toolbar at the top of the screen. Then click "Save." You will get a message that says "PCBs-SchoolsDose is a "read-only" file." To save a copy, click OK, then give the workbook a new name in the save as dialog box. Then click "Save."

Tab D Input Values and Assumptions

Variable Name	Variable Description (units)	Grade Level and Age (years)							Assumptions
		Daycare Toddler		Pre-school	Elementary	Middle	High	Staff	
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult	
Concentrations – Background									
C_{dust}	Concentration of PCBs in background dust (µg/g)	0.27	0.27	0.27	0.27	0.27	0.27	0.27	Average of central tendency values (means and geometric means) from 4 studies that collected dust samples from indoor background locations in the U.S.: Arnold et al., 2018 (mean of 14 samples from senior living facilities in Indiana; sum of 82 congeners = 0.092 µg/g, range = 0.024 - 0.750 µg/g); Harrad et al., 2009 (mean sum of PCBs containing 3 to 7 chlorines from 20 homes in Texas = 0.22 µg/g, range = 0.047 - 0.62 µg/g); Hwang et al., 2008 (mean of 10 apartments and 1 community hall in California; sum of 54 congeners = 0.075 µg/g, range = <0.01 - 0.57 µg/g); and Vorhees et al., 1999 (geometric mean for homes (n=15) in Massachusetts; sum of 65 congeners = 0.69 µg/g, range = 0.26 - 3.6 µg/g).
C_{soil}	Concentration of PCBs in background soil (µg/g)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	Average of central tendency values (mean and geometric mean) from 2 studies that collected soil samples from background locations in the U.S.: Martinez et al., 2012 (mean of 64 samples from residential locations in Iowa; sum of 164 congeners = 0.056 µg/g, range = 0.003 - 1.2 µg/g); and Vorhees et al., 1999 (geometric mean of 16 samples from residential homes in Massachusetts; sum of 65 congeners = 0.06 µg/g, range = 0.015 - 0.29 µg/g).
$C_{air\text{-}indoor}$	Concentration of PCBs in non-school indoor air (ng/m^3)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	Average of central tendency values (mean and geometric means) from 3 studies that collected indoor air samples from background locations in the U.S.: Ampleman et al., 2015 [mean of geometric means for homes in Indiana (1.0 ng/m^3; n=34) and Iowa (0.44 ng/m^3; n=35), and schools in Indiana (6.4 ng/m^3; n=13) and Iowa (8.4 ng/m^3; n=11); total of 201 congeners]; Fitzgerald et al., 2011 (mean of 176 samples collected from homes in New York based on Aroclors 1242, 1254, 1260 = 14 ng/m^3, range = 0.6 - 233 ng/m^3); and Vorhees et al. (1997); geometric mean of 16 homes in Massachusetts; total of 65 congeners = 10 ng/m^3, range = 5.2 - 51 ng/m^3). A study by Marek et al., 2017 reported a range of 0.5 - 194 ng/m^3 for 6 schools in Iowa and Indiana based on 209 PCB congeners.
$C_{air\text{-}outdoor}$	Concentration of PCBs in non-school outdoor air (ng/m^3)	0.53	0.53	0.53	0.53	0.53	0.53	0.53	Average of central tendency values (means and medians) from 5 studies that collected outdoor air samples from background locations in the U.S.: Marek et al., 2017 (median values for outdoor air at 5 schools in Indiana and Iowa; sum of 209 congeners = 0.21, 0.584, 0.183, 0.36, 0.159 ng/m^3, range = 0.03-3 ng/m^3); Yan et al., 2008 [data for a park (0.7 ng/m^3) and urban area (1.2 ng/m^3) in New Jersey; sum of 90 congeners]; Vorhees et al., 1997 (geometric mean of 20 homes in Massachusetts; total of 65 congeners = 0.6 ng/m^3, range = 0.1- 8.2 ng/m^3); Hu et al., 2010 (mean sum of 209 PCB congeners in 184 ambient air samples from 37 sites in Chicago, Illinois = 0.84 ng/m^3, range = 0.075 - 5.5 ng/m^3); and Palmer et al., 2008 (median sum of 84 congeners for a comparison site in New York = 0.431 ng/m^3 (n=85); range = 0.080 - 2.366 ng/m^3).
Concentrations - Schools									
C_{dust}	Concentration of PCBs in dust (µg/g)	0.27	0.27	0.27	0.27	0.27	0.27	0.27	Values are set equal to background concentrations, but can be changed by the user to reflect school-specific concentrations or relevant values from the literature.
C_{soil}	Concentration of PCBs in soil (µg/g)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	Values are set equal to background concentrations, but can be changed by the user to reflect school-specific concentrations or relevant values from the literature.
$C_{air\text{-}indoor}$	Concentration of PCBs in indoor air (ng/m^3)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	Values are set equal to background concentrations, but can be changed by the user to reflect school-specific concentrations or relevant values from the literature.
$C_{air\text{-}outdoor}$	Concentration of PCBs in outdoor air (ng/m^3)	0.53	0.53	0.53	0.53	0.53	0.53	0.53	Values are set equal to background concentrations, but can be changed by the user to reflect school-specific concentrations or relevant values from the literature.
Dietary Dose Assumptions									

--	Dietary Dose; Food Ingestion (µg/kg-day)	0.002	0.002	0.002	0.001	0.001	0.001	0.001	Based on FDA Total Diet Study data for foods collected in 2003 as provided by Katie Egan, FDA, in a personal communication to Linda Phillips, EPA, October 26, 2010 and in a memo from Judith Spungen to Linda Phillips, FDA, June 23, 2014. Total Diet Study data for earlier years was presented in ATSDR (2000). Data represent administered doses. Intake based only on foods in which PCBs were detected (non-detects assumed to be zero). Data represent general population exposures and may not accurately represent populations that regularly consume fish with higher than typical PCB tissue concentrations or populations that consume fish as a greater than average percentage of diet.
Exposure Factors									
$IngR_{dust}$	Dust Ingestion Rate (mg/day)	50	30	30	30	20	20	20	Central tendency values for soil and dust ingestion are the mean recommended rates from U.S. EPA (2017). High-end soil ingestion values from U.S. EPA (2017) are 90 mg/day for children 1 to <12 years and 50 mg/day for ages 12 years through adult. High-end dust ingestion values are: 100 mg/day for children 1 to <12 years and 60 mg/day for ages 12 years through adult.
$IngR_{soil}$	Soil Ingestion Rate (mg/day)	40	30	30	30	10	10	10	
IR	Inhalation Rate (m^3/day)	8.0	8.9	10.1	12.0	15.2	16.3	15.9	Central tendency values for are mean recommended values from U.S. EPA (2011). Upper percentile values are 12.8, 13.7, 13.8, 16.6, 21.9, 24.6, and 21.3 m^3/day for ages 1 to <2, 2 to <3, 3 to <6, 6 to <11, 11 to <15, 15 to <19 years, and adults, respectively. Adult values are an average of the following age groups 21 to<31; 31 to< 41; 41 to<51; and 51 to<61 from U.S. EPA (2011).
Ad	Dermal (dust) Adherence Factor (mg/cm^2-d)	0.042	0.038	0.038	0.005	0.005	0.005	0.003	Children's values based on weighted average of geometric mean soil loadings for 2 groups of children (ages 3 to 13 years; N = 10) playing indoors (U.S. EPA, 2011). Values are weighted according to proportion of body parts exposed. Adult adherence value calculated based on geometric mean soil loadings of 6 children (ages >8 years) and 1 adult engaging in Tae Kwon Do. (See Columns T to AL; Rows 27 to 33 of this spreadsheet for details.)
SA	Dermal Surface Area Exposed (cm^2)	1,155	1,365	1,714	2,553	3,852	4,427	4,991	Mean values for hands + forearms + lower legs from U.S. EPA (2011). See below for details.
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80.0	Mean recommended values from U.S. EPA (2011).
Exposure Frequency/Duration									
ST	Sleep time (hours/day)	13.0	11.9	11.4	10.2	9.5	9.0	8.3	Central tendency values represent mean amounts of time spent sleeping/napping for children and adults (18 to 64 years of age) from U.S. EPA (2011). Lower percentile (5th) values are 9.7, 8.7, 9.0, 7.6, 6.9, 6.0, and 5.5 hours/day for ages 1 to <2, 2 to <3, 3 to <6, 6 to <11, 11 to <15, 15 to < 19, and adults, respectively (U.S. EPA, 2011).
WT	Awake time (hours/day)	11	12.1	12.6	13.8	14.5	15	15.7	Calculated as 24 hours minus sleeping time (ST).
OT	Outdoor time (hours/day)	0.6	1.3	1.8	2.2	1.7	1.7	4.7	Represents the average amount of time spent outdoors (U.S. EPA, 2011).
IT	Indoor time (hours/day)	23.4	22.7	22.2	21.8	22.3	22.3	19.3	Calculated as 24 hours minus outdoor time (OT).
EFs	Exposure frequency in school (days/year)	185	185	180	180	180	180	185	The assumed exposure duration for children ages 3 to <19 is 180 days/year; 185 days/year is assumed for teachers/staff and daycare children; upper range may be 208 days/years for staff and daycare. Based on National Center for Educatinal Statistics (NCES, 2019) data for 2018, the minimum number of days in school as required by States having such requirements, ranges from 160 to 186 days/year, with 180 days/year being the most common requirement (29 of 40 States). It is reasonable to assume that some schools run summer camp programs and the days spent at school for some children and staff may be as high as 240 days (180 + 60 days of summer camp).

Body Part	Dermal Surface Area Exposed (cm^2)						
	1 to <2 yrs	2 to <3 yrs	3 to <6 yrs	6 to <12 yrs	12 to <15 yrs	16 to <21 yrs	Adult
hands	300	280	370	510	720	830	980
forearms (assumed to be 55% of arms)	380	484	583	831	1,349	1,480	1,515
lower legs (assumed to be 39% of legs)	476	601	761	1,213	1,884	2,118	2,496
Total	1,155	1,365	1,714	2,553	3,852	4,427	4,991

ETst	Total exposure time in school (hours/day)	8.0	8.0	6.5	6.5	6.5	6.5	8.0	Estimated as the sum of indoor (Etsi) and outdoor time (Etso) at school.
ETsi	Indoor time at school (hours/day)	7.5	7.5	6.0	6.0	6.0	6.0	8.0	Mean total time in school (ETst) was assumed to be 6.5 hours/day for school age children and pre-school age (3 to <6 years) and 8 hours/day for adults and daycare toddlers (ages 1 to <3 years). Times spent attending school full-time from U.S. EPA (2011; Table 16-25) are 6.4, 6.1, 6.5, 6.7, and 5.8 hours/day for children ages 2 to <3, 3 to <6, 6 to <11, 11 to <16, and 16 to <21 years, respectively. Upper percentile (95th) values for these age groups of children are 10.5, 9.7, 8.3, 8.1, and 8.7 hours/day, respectively. The assumption of 6.5 hours/day for school-age children appears to be supported by data provided by NCES (2019) for the minimum required length of hours/year in school by state. Among the states with such requirement, minimum length of a school day ranges from 720 hours/year or 4 hours/day (excluding half-day kindergarten), assuming 180 days/year, to 1,260 hours/year or 7 hours/day, assuming 180 days/year in school. For adults, U.S. EPA (2011) presents mean and upper percentile values of 4.9 and 8.9 hours/day for time spent in school. It is reasonable to assume that teachers and staff work full time (8 hours/day) in the school building; it is also reasonable to assume that their toddler children are in daycare for the same amount of time. There are no data regarding the amount of time staff spend in the school building. It is reasonable to assume that highly exposed staff members may spend 10 hrs/day in school building supervising after school daycare or activities.
ETso	Outdoor time at school (hours/day)	0.5	0.5	0.5	0.5	0.5	0.5	0	It was assumed that children spend 30 minutes of their school day outside (i.e., at recess or physical education activities) for both central tendency and reasonable maximum exposure; no outdoor time is assumed for adults.
Fias	Fraction of indoor awake time (over a year) spent at school (unitless)	0.37	0.35	0.27	0.26	0.23	0.22	0.37	Calculated: Fias = (ETsi * EFs) / ((IT - ST) * 365 days/yr))
Fians	Fraction of indoor awake time (over a year) not spent at school (unitless)	0.63	0.65	0.73	0.74	0.77	0.78	0.63	Calculated: Fians = 1 - (ETsi * EFs) / ((IT - ST) * 365 days/yr))
Fots	Fraction of outdoor time (over a year) spent at school (unitless)	0.42	0.19	0.14	0.11	0.15	0.15	0.00	Calculated: Fots = (ETso * EFs) / (OT * 365 days/yr)
Fotns	Fraction of outdoor time (over a year) not spent at school (unitless)	0.58	0.81	0.86	0.89	0.85	0.85	1.00	Calculated: Fotns = 1 - (ETso * EFs) / (OT * 365 days/yr)
Fttis	Fraction of total time (over a year) spent indoor at school (unitless)	0.16	0.16	0.12	0.12	0.12	0.12	0.17	Calculated: Fttis = (ETsi * EFs) / (24 hr/day * 365 days/yr)
Fttins	Fraction of total time (over a year) spent indoors not at school (unitless)	0.82	0.79	0.80	0.79	0.81	0.81	0.64	Calculated: Fttins = ((IT * 365 day/yr) - (ETsi * EFs)) / (24 hr/day * 365 days/yr)
Fttos	Fraction of total time (over a year) spent outdoor at school (unitless)	0.01	0.01	0.01	0.01	0.01	0.01	0.00	Calculated: Fttos = (Etso * EFs)/(24 hr/day * 365 days/yr)

Fttons	Fraction of total time (over a year), spent outdoors not at school (unitless)	0.01	0.04	0.06	0.08	0.06	0.06	0.20	Calculated: Fttons = ((OT * 365 days/yr)-(ETso * EFs)) / (24 hr/day * 365 days/yr)
Fs	Fraction of year in school (unitless)	0.51	0.51	0.49	0.49	0.49	0.49	0.51	Calculated: EFs = Fs/365 days/yr
Relative Absorption Factors									
$Abs_{dust-soil}$	Relative absorption factor for dust and soil ingestion (fraction)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	Estimated as soil oral absorption fraction/food oral absorption fraction = 0.5 / 0.8. Absorption fraction for soil is assumed to be 50% based on data for dioxins (U.S. EPA, 2003). Absorption fraction for food is assumed to be 80% based on data for dioxins. According to EPA's dioxin reassessment (U.S. EPA, 2003) "in Sprague-Dawley rats given a single oral dose of 1.0 µg [14C]-2,3,7,8-TCDD/kg bw in acetone:corn oil (1:25, v/v), the fraction absorbed ranged from 66% to 93%, with a mean of ~84%" and "The oral bioavailability of ... 3,3',4,4'-TCB in corn oil was similar to that of 2,3,7,8-TCDD." 80% was assumed to represent the mean oral absorption fraction for PCBs.
Abs_{air}	Relative absorption factor for indoor and outdoor air inhalation (fraction)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	The absorption fraction for inhaled PCBs is assumed to be the same as for ingested PCBs. This is based on information for dioxins indicating a very high inhalation absorption (U.S. EPA, 2003)
Abs_{dermal}	Relative absorption factor for dermal (dust) contact (fraction)	0.09	0.09	0.09	0.09	0.09	0.09	0.09	Dermal absorption fraction for PCB in soil is assumed to be 7%. This value is the midpoint from 6 studies that estimated the dermal absorption of Aroclors 1242, 1254, or 1260, or 3,3',4,4'-tetrachlorobiphenyl over a 24-hour period using human skin (in vitro) or monkey (in vivo) experiments (see Table 7 in Roy et al., 2009). Relative Abs estimated as soil dermal absorption fraction/food oral absorption fraction = 0.07/ 0.8.

Tab E Total Exposure Doses

Table E-1: Summary of Background (Non-school) and School Doses

Exposure Scenario	Daycare				Pre-school		Elementary		Middle		High		Staff	
	Age 1 to <2 yrs		Age 2 to <3 yrs		Age 3 to <6 yrs		Age 6 to <12 yrs		Age 12 to <15 yrs		Age 15 to <19 yrs		Adult	
	Dose ng/kg-day	% of Total	Dose ng/kg-day	% of Total	Dose ng/kg-day	% of Total	Dose ng/kg-day	% of Total	Dose ng/kg-day	% of Total	Dose ng/kg-day	% of Total	Dose ng/kg-day	% of Total
Background (Non-school) Exposures														
Dust Ingestion	0.5	5.9%	0.2	3.4%	0.2	3.3%	0.1	3.2%	0.0	1.6%	0.0	1.4%	0.0	1.2%
Soil Ingestion	0.1	1.0%	0.1	0.9%	0.1	0.9%	0.0	0.9%	0.0	0.2%	0.0	0.2%	0.0	0.2%
Indoor Air Inhalation	3.8	50.6%	3.4	51.0%	2.9	50.0%	2.0	56.4%	1.4	52.6%	1.2	49.4%	0.8	39.5%
Outdoor Air Inhalation	0.0	0.1%	0.0	0.2%	0.0	0.3%	0.0	0.5%	0.0	0.3%	0.0	0.3%	0.0	1.0%
Dermal Absorption	0.1	1.4%	0.1	1.4%	0.1	1.5%	0.0	0.3%	0.0	0.3%	0.0	0.3%	0.0	0.2%
Diet	2.0	26.4%	2.0	30.0%	2.0	34.3%	1.0	28.4%	1.0	36.3%	1.0	40.2%	1.0	46.6%
Total Background (Non-school) Dose	**6.5**	85.3%	**5.8**	86.9%	**5.3**	90.2%	**3.2**	89.7%	**2.5**	91.3%	**2.3**	91.8%	**1.9**	88.7%
School Exposures														
Dust Ingestion	0.3	3.4%	0.1	1.9%	0.1	1.2%	0.0	1.1%	0.0	0.5%	0.0	0.4%	0.0	0.7%
Soil Ingestion	0.1	0.7%	0.0	0.2%	0.0	0.1%	0.0	0.1%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Indoor Air Inhalation	0.7	9.8%	0.7	10.3%	0.4	7.7%	0.3	8.9%	0.2	8.0%	0.2	7.6%	0.2	10.5%
Outdoor Air Inhalation	0.0	0.1%	0.0	0.1%	0.0	0.1%	0.0	0.1%	0.0	0.1%	0.0	0.0%	0.0	0.0%
Dermal Absorption	0.1	0.7%	0.0	0.7%	0.0	0.7%	0.0	0.1%	0.0	0.2%	0.0	0.2%	0.0	0.1%
Total School Dose	**1.1**	14.7%	**0.9**	13.1%	**0.6**	9.8%	**0.4**	10.3%	**0.2**	8.7%	**0.2**	8.2%	**0.2**	11.3%
Total (Non-school plus School) Dose	**7.6**	**100.0%**	**6.7**	**100.0%**	**5.8**	**100.0%**	**3.5**	**100.0%**	**2.8**	**100.0%**	**2.5**	**100.0%**	**2.1**	**100.0%**
RfD (Reference Dose) from U.S. EPA (2019) IRIS	20	ng/kg-day	20	ng/kg-day	20	ng/kg-day	20	ng/kg-day	20	ng/kg-day	20	ng/kg-day	20	ng/kg-day
Maximum PCB concentration (ng/m^3) in school indoor air without exceeding RfD, and assuming all other exposure pathways (including background) remain unchanged.	**118**		**137**		**218**		**361**		**529**		**631**		**538**	

* Calculated as the RfD minus the total dose plus the indoor school inhalation; remainder is converted to the concentration in indoor school air to which individuals can be exposed without exceeding the RfD.
$Conc_{air\text{-}max}$ = [(RfD - Total Dose + School Inhalation Dose) x Body Weight] / [Inhalation Rate x Fraction of Time in School x Relative Absorption]
These values, rounded to one significant figure, have been used to represent Exposure Levels for Evaluating PCBs in Indoor School Air (ELEs).
For information about the ELEs, see:
- https://www.epa.gov/pcbs/exposure-levels-evaluating-polychlorinated-biphenyls-pcbs-indoor-school-air, and
- https://www.epa.gov/sites/production/files/2016-03/documents/pcbs_in_building_materials_questions_and_answers.pdf.

Tab F Estimates of Background (Non-school) Doses

Background (non-school) PCB exposure can occur via non-dietary dust and soil ingestion, inhalation, dermal absorption and dietary (food) ingestion. Example input values are provided and may need to be modified to reflect conditions at a specific site or for a specific population.

Equation F-1. Dust Ingestion:

$$ADD_{dust} = (C_{dust} \times IngR_{dust} \times Fians \times CF \times Abs_{dust\text{-}soil}) / BW$$

Table F-1: Input Parameters for Dose from Dust Ingestion - Background (Non-school) Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
C_{dust}	Dust concentration (µg/g)	0.27	0.27	0.27	0.27	0.27	0.27	0.27
$IngR_{dust}$	Dust ingestion rate (mg/day)	50	30	30	30	20	20	20
Fians	Fraction of indoor awake time (over a year) not spent at school (unitless)	0.63	0.65	0.73	0.74	0.77	0.78	0.63
CF	Conversion factor (g/1,000 mg)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
$Abs_{dust\text{-}soil}$	Relative absorption factor (fraction)	0.6	0.6	0.6	0.6	0.6	0.6	0.6
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80.0
ADD_{dust}	**Average daily dose (µg/kg-day)**	**4.5E-04**	**2.3E-04**	**1.9E-04**	**1.1E-04**	**4.4E-05**	**3.5E-05**	**2.6E-05**
	Percent of overall background dose	**7.0%**	**3.9%**	**3.6%**	**3.6%**	**1.7%**	**1.5%**	**1.3%**
	Percent of total (non-school plus school) dose	**5.9%**	**3.4%**	**3.3%**	**3.2%**	**1.6%**	**1.4%**	**1.2%**

Equation F-2. Soil Ingestion:

$$ADD_{soil} = (C_{soil} \times IngR_{soil} \times Fotns \times CF \times Abs_{dust\text{-}soil}) / BW$$

Table F-2: Input Parameters for Dose from Soil Ingestion - Background (Non-school) Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
C_{soil}	Soil concentration (µg/g)	0.06	0.06	0.06	0.06	0.06	0.06	0.06
$IngR_{soil}$	Soil ingestion rate (mg/day)	40	30	30	30	10	10	10
Fotns	Fraction of outdoor time (over a year) not spent at school (unitless)	0.58	0.81	0.86	0.89	0.85	0.85	1.00
CF	Conversion factor (g/1,000 mg)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
$Abs_{dust\text{-}soil}$	Relative absorption factor (fraction)	0.6	0.6	0.6	0.6	0.6	0.6	0.6
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80.0
ADD_{soil}	**Average daily dose (µg/kg-day)**	**7.3E-05**	**6.3E-05**	**5.0E-05**	**3.0E-05**	**5.4E-06**	**4.3E-06**	**4.5E-06**
	Percent of overall background dose	**1.1%**	**1.1%**	**1.0%**	**1.0%**	**0.2%**	**0.2%**	**0.2%**
	Percent of total (non-school plus school) dose	**1.0%**	**0.9%**	**0.9%**	**0.9%**	**0.2%**	**0.2%**	**0.2%**

Equation F-3. Indoor Inhalation:

$$ADD_{inhalation\text{-}indoor} = (C_{air\text{-}indoor} \times IR \times Fttins \times CF_1 \times Abs_{air}) / BW$$

Table F-3: Input Parameters for Dose from Inhalation of Indoor Air - Background (Non-school) Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
$C_{air\text{-}indoor}$	Air concentration (ng/m^3)	6.7	6.7	6.7	6.7	6.7	6.7	6.7
IR	Inhalation rate (m^3/day)	8.0	8.9	10.1	12.0	15.2	16.3	15.9
Fttins	Fraction of total time (over a year) spent indoors not at school (unitless)	0.82	0.79	0.80	0.79	0.81	0.81	0.64
CF_1	Conversion factor 1 (µg/1,000 ng)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Abs_{air}	Relative absorption factor (fraction)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80
$ADD_{inhalation\text{-}indoor}$	**Average daily dose (µg/kg-day)**	**3.8E-03**	**3.4E-03**	**2.9E-03**	**2.0E-03**	**1.4E-03**	**1.2E-03**	**8.5E-04**
	Percent of overall background dose	**59.3%**	**58.7%**	**55.4%**	**62.9%**	**57.6%**	**53.8%**	**44.5%**
	Percent of total (non-school plus school) dose	**50.6%**	**51.0%**	**50.0%**	**56.4%**	**52.6%**	**49.4%**	**39.5%**

Equation F-4. Outdoor Inhalation:

$$ADD_{inhalation\text{-}outdoor} = (C_{air\text{-}outdoor} \times IR \times Fttons \times CF_1 \times Abs_{air}) / BW$$

Table F-4: Input Parameters for Dose from Inhalation of Outdoor Air - Background (Non-school) Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
$C_{air\text{-}outdoor}$	Air concentration (ng/m^3)	0.53	0.53	0.53	0.53	0.53	0.53	0.53
IR	Inhalation rate (m^3/day)	8.0	8.9	10.1	12.0	15.2	16.3	15.9
Fttons	Fraction of total time (over a year), spent outdoors not at school (unitless)	0.01	0.04	0.06	0.08	0.06	0.06	0.20
CF_1	Conversion factor 1 (µg/1,000 ng)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Abs_{air}	Relative absorption factor (fraction)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80
$ADD_{inhalation\text{-}outdoor}$	**Average daily dose (µg/kg-day)**	**5.4E-06**	**1.5E-05**	**1.9E-05**	**1.6E-05**	**8.4E-06**	**7.3E-06**	**2.1E-05**
	Percent of overall background dose	**0.1%**	**0.3%**	**0.4%**	**0.5%**	**0.3%**	**0.3%**	**1.1%**
	Percent of total (non-school plus school) dose	**0.1%**	**0.2%**	**0.3%**	**0.5%**	**0.3%**	**0.3%**	**1.0%**

Equation F-5. Dermal Absorption from Indoor Dust Contact:

$$ADD_{dermal} = (C_{dust} \times Ad \times SA \times CF \times Abs_{dermal}) / BW$$

Table F-5: Input Parameters for Dermal Absorption from Indoor Dust Contact - Background (Non-school) Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
C_{dust}	Dust concentration (µg/g)	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Ad	Dust to skin adherence (mg/cm^2-day)	0.0418	0.0376	0.0384	0.0052	0.0051	0.0051	0.003
SA	Skin contact area (cm^2)	1,155	1,365	1,714	2,553	3,852	4,427	4,991
CF	Conversion factor (g/1,000 mg)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Abs_{dermal}	Relative absorption factor (fraction)	0.09	0.09	0.09	0.09	0.09	0.09	0.09
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80
ADD_{dermal}	**Average daily dose (µg/kg-day)**	**1.0E-04**	**9.0E-05**	**8.6E-05**	**1.0E-05**	**8.4E-06**	**7.7E-06**	**4.5E-06**
	Percent of overall background dose	**1.6%**	**1.6%**	**1.6%**	**0.3%**	**0.3%**	**0.3%**	**0.2%**
	Percent of total (non-school plus school) dose	**1.4%**	**1.4%**	**1.5%**	**0.3%**	**0.3%**	**0.3%**	**0.2%**

Table F-6: Dietary Ingestion - Background (Non-school) Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
ADD_{food}	**Average daily dose (µg/kg-day)**	**2.0E-03**	**2.0E-03**	**2.0E-03**	**1.0E-03**	**1.0E-03**	**1.0E-03**	**1.0E-03**
	Percent of overall background dose	**30.9%**	**34.5%**	**38.0%**	**31.7%**	**39.8%**	**43.8%**	**52.6%**
	Percent of total (non-school plus school) dose	**26.4%**	**30.0%**	**34.3%**	**28.4%**	**36.3%**	**40.2%**	**46.6%**

Tab G Estimates of Doses Occurring in Schools

PCB exposure in schools can occur via nondietary dust and soil ingestion, inhalation and dermal absorption. Example input values are provided and may need to be modified to reflect conditions at a specific site or for a specific population.

Equation G-1. Dust Ingestion:

$$ADD_{dust} = (C_{dust} \times IngR_{dust} \times F_{ias} \times CF \times Abs_{dust\text{-}soil}) / BW$$

Table G-1: Input Parameters for Dose from Dust Ingestion - School Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
C_{dust}	Dust concentration (µg/g)	0.27	0.27	0.27	0.27	0.27	0.27	0.27
$IngR_{dust}$	Dust ingestion rate (mg/day)	50	30	30	30	20	20	20
Fias	Fraction of indoor awake time (over a year) spent at school (unitless)	0.37	0.35	0.27	0.26	0.23	0.22	0.37
CF	Conversion factor (g/1,000 mg)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
$Abs_{dust\text{-}soil}$	Relative absorption factor (fraction)	0.6	0.6	0.6	0.6	0.6	0.6	0.6
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80
ADD_{dust}	**Average daily dose (µg/kg-day)**	**2.6E-04**	**1.2E-04**	**7.2E-05**	**3.9E-05**	**1.3E-05**	**1.0E-05**	**1.5E-05**
	Percent of overall school dose	**23.3%**	**14.2%**	**12.5%**	**10.8%**	**5.5%**	**4.9%**	**6.2%**
	Percent of total (non-school plus school) dose	**3.4%**	**1.9%**	**1.2%**	**1.1%**	**0.5%**	**0.4%**	**0.7%**

Equation G-2. Soil Ingestion:

$$ADD_{soil} = (C_{soil} \times IngR_{soil} \times Fots \times CF \times Abs_{dust\text{-}soil}) / BW$$

Table G-2: Input Parameters for Dose from Soil Ingestion - School Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
C_{soil}	Soil concentration (µg/g)	0.06	0.06	0.06	0.06	0.06	0.06	0.06
$IngR_{soil}$	Soil ingestion rate (mg/day)	40	30	30	30	10	10	10
Fots	Fraction of outdoor time (over a year) spent at school (unitless)	0.42	0.19	0.14	0.11	0.15	0.15	0.00
CF	Conversion factor (g/1,000 mg)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
$Abs_{dust\text{-}soil}$	Relative absorption factor (fraction)	0.6	0.6	0.6	0.6	0.6	0.6	0.6
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80
ADD_{soil}	**Average daily dose (µg/kg-day)**	**5.3E-05**	**1.5E-05**	**8.0E-06**	**3.8E-06**	**9.4E-07**	**7.3E-07**	**0.0E+00**
	Percent of overall school dose	**4.8%**	**1.7%**	**1.4%**	**1.1%**	**0.4%**	**0.4%**	**0.0%**
	Percent of total (non-school plus school) dose	**0.7%**	**0.2%**	**0.1%**	**0.1%**	**0.0%**	**0.0%**	**0.0%**

Equation G-3. Indoor Inhalation:

$$ADD_{inhalation\text{-}indoor} = (C_{air\text{-}indoor} \times IR \times Fttis \times CF_1 \times Abs_{air}) / BW$$

Table G-3: Input Parameters for Dose from Indoor Inhalation - School Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
$C_{air\text{-}indoor}$	Air concentration (ng/m^3)	6.7	6.7	6.7	6.7	6.7	6.7	6.7
IR	Inhalation rate (m^3/day)	8.0	8.9	10.1	12.0	15.2	16.3	15.9
Fttis	Fraction of total time (over a year) spent indoor at school (unitless)	0.16	0.16	0.12	0.12	0.12	0.12	0.17
CF_1	Conversion factor 1 (µg/1,000 ng)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Abs_{air}	Relative absorption factor (fraction)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80
$ADD_{inhalation\text{-}indoor}$	**Average daily dose (µg/kg-day)**	**7.4E-04**	**6.8E-04**	**4.5E-04**	**3.1E-04**	**2.2E-04**	**1.9E-04**	**2.2E-04**
	Percent of overall school dose	**66.9%**	**78.4%**	**78.2%**	**86.2%**	**91.8%**	**92.2%**	**92.9%**
	Percent of total (non-school plus school) dose	**9.8%**	**10.3%**	**7.7%**	**8.9%**	**8.0%**	**7.6%**	**10.5%**

Equation G-4. Outdoor Inhalation:

$$ADD_{inhalation\text{-}outdoor} = (C_{air\text{-}outdoor} \times IR \times Fttos \times CF_1 \times Abs_{air}) / BW$$

Table G-4: Input Parameters for Dose from Outdoor Inhalation - School Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
$C_{air\text{-}outdoor}$	Air concentration (ng/m^3)	0.53	0.53	0.53	0.53	0.53	0.53	0.53
IR	Inhalation rate (m^3/day)	8.0	8.9	10.1	12.0	15.2	16.3	15.9
Fttos	Fraction of total time (over a year) spent outdoor at school (unitless)	0.01	0.01	0.01	0.01	0.01	0.01	0.00
CF_1	Conversion factor 1 (µg/1,000 ng)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Abs_{air}	Relative absorption factor (fraction)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80
$ADD_{inhalation\text{-}outdoor}$	**Average daily dose (µg/kg-day)**	**3.9E-06**	**3.6E-06**	**3.0E-06**	**2.1E-06**	**1.5E-06**	**1.2E-06**	**0.0E+00**
	Percent of overall school dose	**0.4%**	**0.4%**	**0.5%**	**0.6%**	**0.6%**	**0.6%**	**0.0%**
	Percent of total (non-school plus school) dose	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.0%**	**0.0%**

Equation G-5. Dermal Absorption from Indoor Dust Contact:

$$ADD_{dermal} = (C_{dust} \times Ad \times SA \times CF \times Fs \times Abs_{dermal}) / BW$$

Table G-5: Input Parameters for Dermal Absorption from Indoor Dust Contact - School Exposure

Variable Name	Variable Description (Name)	Grade Level and Age (years)						
		Daycare Toddler		Pre-sch	Elementary	Middle	High	Staff
		1 to <2	2 to <3	3 to <6	6 to <12	12 to <15	15 to <19	Adult
C_{dust}	Dust concentration (µg/g)	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Ad	Dust to skin adherence (mg/cm^2-day)	0.042	0.038	0.038	0.005	0.005	0.005	0.003
SA	Skin contact area (cm^2)	1,155	1,365	1,714	2,553	3,852	4,427	4,991
CF	Conversion factor (g/1,000 mg)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Fs	Fraction of year in school (unitless)	0.51	0.51	0.49	0.49	0.49	0.49	0.51
Abs_{dermal}	Relative absorption factor (fraction)	0.09	0.09	0.09	0.09	0.09	0.09	0.09
BW	Body weight (kg)	11.4	13.8	18.6	31.8	56.8	71.6	80
ADD_{dermal}	**Average daily dose (µg/kg-day)**	**5.2E-05**	**4.6E-05**	**4.2E-05**	**5.0E-06**	**4.1E-06**	**3.8E-06**	**2.2E-06**
	Percent of overall school dose	**4.7%**	**5.2%**	**7.4%**	**1.4%**	**1.7%**	**1.9%**	**0.9%**
	Percent of total (non-school plus school) dose	**0.7%**	**0.7%**	**0.7%**	**0.1%**	**0.2%**	**0.2%**	**0.1%**

Tab H References

Ampleman, MD; Martinez, A; Dewall, J; Rawn, DF; Hornbuckle, KC; Thorne, PC (2015) Inhalation and dietary exposure to PCBs in urban and rural cohorts via congener-specific measurements. Environmental Science and Technology. 49:1156-1164. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2920071

Arnold, K; Teixeira, JP; Mendes, A; Madureira, J; Costa, A; Salamova, A (2018) A pilot study on semivolatile organic compounds in senior care facilities: Implications for older adult exposures. Environmental Pollution. 240:908-915. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/5016984

ATSDR, 2000. Toxicological Profile for PCBs. Agency for Toxic Substances and Disease Registry. Available at: https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=142&tid=26

ATSDR, 2000. Toxicological Profile for PCBs. Agency for Toxic Substances and Disease Registry.

Egan, K. (2010) FDA Total Diet Study data and exposure estimates for foods collected in 2003, spreadsheet provided by Katie Egan, FDA, by personal communication to Linda Phillips, EPA, October 26, 2010.

Fitzgerald, EF; Shrestha, A; Palmer, PM; Wilson, LR; Belanger, EE; Gomez, MI; Cayo, MR; Hwang, SA (2011) Polychlorinated biphenyls (PCBs) in indoor air and in serum among older residents of upper Hudson River communities. Chemosphere. 85:225-231. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2151223

Harrad, S; Ibarra, C; Robson, M; Melymuk, L; Zhang, X; Diamond, M; Douwes, J (2009) Polychlorinated biphenyls in domestic dust from Canada, New Zealand, United Kingdom and United States: Implications for human exposure. Chemosphere. 76:232-238. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198193

Hu, D; Lehmler, HJ; Martinez, A; Wang, K; Hornbuckle, KC (2010) Atmospheric PCB Congeners across Chicago. Atmospheric Environment. 44:1550-1557.

Hwang, HM; Park, EK; Young, TM; Hammock, BD (2008) Occurrence of endocrine-disrupting chemicals in indoor dust. Science of the Total Environment. 404:26-35. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/198203.

Marek, RF; Thorne, PS; Herkert, NJ; Awad, AM; Hornbuckle, KC (2017) Airborne PCBs and OH-PCBs Inside and Outside Urban and Rural U.S. Schools. Environmental Science and Technology. 51:7853-7860. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/3984192.

Martinez, A; Erdman, NR; Rodenburg, ZL; Eastling, PM; Hornbuckle, KC (2012) Spatial distribution of chlordanes and PCB congeners in soil in Cedar Rapids, Iowa, USA. Environmental Pollution. 161:222-228. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2150856.

National Center for Educational Statistics (NCES) (2019) Education Commission of the States, 50 State Comparison: Instructional Time Policies, Table 5.14. Number of instructional days and hours in the school year, by state: 2018. Accessed online 4/11/19 at https://nces.ed.gov/programs/statereform/tab5_14.asp.

Palmer, PM; Belanger, EE; Wilson, LR; Hwang, SA; Narang, RS; Gomez, MI; Cayo, MR; Durocher, LA; Fitzgerald, EF (2008) Outdoor air PCB concentrations in three communities along the Upper Hudson River, New York. Arch. Environ. Contam. Toxicol. 54 (3), 363–371.

Roy, T.A.; Hammerstrom, K.; Schaum, J., 2009. Percutaneous absorption of 3,3',4,4'-tetrachlorobiphenyl (PCB 77) from soil. J Tox Env Health Part A. 72:350-357.

Spungen, J. 2014. Estimated dietary exposure to PCBs based on 2003 Total Diet Study results. Memo to Linda Phillips, EPA, from Judith Spungen, FDA, dated June 23, 2014.

U.S. EPA, 2003. Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds National Academy Sciences (NAS) Review Draft, Part II: Health Assessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds.

U.S. EPA, 2011. Exposure Factors Handbook: 2011 Edition. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F.

U.S. EPA, 2017. Update for Chapter 5 of the Exposure Factors Handbook: Soil and Dust Ingestion. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-17/384F.

U.S. EPA, 2019. Integrated Risk Information System (IRIS). Accessed April 11, 2019. Available online at: https://www.epa.gov/iris/.

Vorhees, DJ; Cullen, AC; Altshul, LM (1997) Exposure to Polychlorinated Biphenyls in Residential Indoor Air and Outdoor Air near a Superfund Site. Environ. Sci. Technol., 1997, 31 (12), pp 3612–3618. DOI: 10.1021/es970371o.

Vorhees, DJ; Cullen, AC; Altshul, LM (1999) Polychlorinated biphenyls in house dust and yard soil near a Superfund site. Environmental Science and Technology. 33:2151-2156. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2187227.

Yan, S; Rodenburg, LA; Dachs, J; Eisenreich, SJ (2008) Seasonal air-water exchange fluxes of polychlorinated biphenyls in the Hudson River Estuary. Environmental Pollution. 152:443-451. https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/2156999

Tab I List of Variables/Parameters in Exposure Estimation Tool

Variable Name	Description
$Abs_{dust-soil}$	Relative absorption factor for dust or soil (fraction)
Abs_{air}	Relative absorption factor for air (fraction)
Abs_{dermal}	Relative absorption factor for dermal contact (fraction)
Ad	Dust to skin adherence (mg/cm^2-day)
ADD_{dermal}	Average daily dose from dermal contact (µg/kg-day)
ADD_{dust}	Average daily dose from dust ingestion (µg/kg-day)
ADD_{food}	Average daily dose from food ingestion (µg/kg-day)
$ADD_{inhalation-indoor}$	Average daily dose from inhalation of indoor air (µg/kg-day)
$ADD_{inhalation-outdoor}$	Average daily dose from inhalation of outdoor air (µg/kg-day)
ADD_{soil}	Average daily dose from soil ingestion (µg/kg-day)
BW	Body weight (kg)
$C_{air-indoor}$	Air concentration indoors (ng/m^3)
$C_{air-outdoor}$	Air concentration outdoors (ng/m^3)
C_{dust}	Dust concentration (µg/g)
CF	Conversion factor (g/1,000 mg)
CF_1	Conversion factor 1 (µg/1,000 ng)
C_{soil}	Soil concentration (µg/g)
EF_s	Exposure frequency in school (days/year)
ETsi	Indoor time at school (hours/day)
ETso	Outdoor time at school (hours/day)
ETst	Total exposure time in school (hours/day)
Fias	Fraction of indoor awake time (over a year) spent at school (unitless)
Fians	Fraction of indoor awake time (over a year) not spent at school (unitless)
Fotns	Fraction of outdoor time (over a year) not spent at school (unitless)
Fots	Fraction of outdoor time (over a year) spent at school (unitless)
Fs	Fraction of year in school (unitless)
Fttins	Fraction of total time (over a year) spent indoors not at school (unitless)
Fttis	Fraction of total time (over a year) spent indoor at school (unitless)
Fttons	Fraction of total time (over a year), spent outdoors not at school (unitless)

Fttos	Fraction of total time (over a year) spent outdoor at school (unitless)
$IngR_{dust}$	Dust ingestion rate (mg/day)
Ing_{soil}	Soil ingestion rate (mg/day)
IR	Inhalation rate (m^3/day)
IT	Indoor time (hours/day)
OT	Outdoor time (hours/day)
RfD	Reference Dose for Aroclor 1254 (ng/kg-day)
SA	Skin contact area (cm^2)
ST	Sleep time (hours/day)
WT	Wake time (hours/day)

Tab J Disclosure

The PCB Exposure Assessment Tool was reviewed internally by a multi-disciplinary team of U.S EPA scientists with experience in exposure/risk assessment, but has not been formally reviewed by an external peer review panel. The tool is based on standard exposure assessment practices and techniques, and uses input data from peer reviewed Agency publications and the scientific literature.

Tab K Versions

Version Number	Date Modified	Changes Made
1.0	9/23/2009	--
1.1	10/2/2009	Added version number and date last modified to introduction page. Added 'Disclosure' tab and 'Versions' tab.
1.2	11/2/2010	Revised dietary dose values, based on newer data provided by FDA. These changes resulted in corresponding changes to the total exposures and estimated maximum indoor air concentrations without exceeding the RfD. These changes affected primarily the younger age groups.
1.2-rev	8/3/2015	Added new citation for the dietary intake data on Tab D and added new reference on Tab H.
1.2-rev2	7/24/2017	Added a caveat to dietary intake values on Tab D to indicate that the FDA values represent general population exposures and may not accurately represent populations that regularly consume fish with higher than typical PCB tissue concentrations or populations that consume fish as a greater than average percentage of diet, based on a comment from EPA Region 8.
2.0	4/23/2019	Updated the exposure factors using data from U.S. EPA (2011) and U.S. EPA (2017), and media concentrations based on systematic review of the scientific literature conducted in 2018/2019. Also, updated the National Center for Educational Statistics (NCES,2019) and Integrated Risk Information System (U.S. EPA, 2019) references.

Tab L FDA Dietary Data

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service
Food and Drug Administration

Memorandum

Date: June 23, 2014

From: Judith Spungen, MS, RD -S
Chemical Hazard Assessment Team (CHAT), (HFS-005)
Division of Risk Assessment (DRA), Office of Analytics and Outreach (OAO)

Subject: Estimated Dietary Exposure to PCBs based on 2003 Total Diet Study Results

To: Linda J. Phillips, Ph.D.
National Center for Environmental Assessment
Office of Research and Development
U.S. Environmental Protection Agency

Through: Deborah Senegal, MPH,
Director, CHAT, DRA, OAO (HFS-005)

In response to your June 11, 2014 request for PCB exposure estimates beyond those provided in an August 24, 2012 memo from Katie Egan of FDA-CFSAN to Geniece Lehmann (EPA-NCEA), we are providing PCB exposure estimates for all standard Total Diet Study (TDS) age/gender subgroups.

The exposure estimates provided in the August 24, 2012 memo were based on FDA Total Diet Study (TDS) results from 1993-94 and from 2003. The exposure estimates provided here are based only on data from 2003. The TDS program no longer includes analysis of total PCBs.

The 2003 TDS data are based on analyses of total PCB concentrations in four quarterly samples of each of about 280 foods and beverages. Total PCBs were analyzed using a multi-residue method that determined a total PCB concentration based on a comparison to Aroclor 1254. The Limit of Quantification (LOQ) at the time of the 2003 analyses was 14 ng/g (ppb). The Limit of Detection (LOD) for the TDS PCB method was estimated by the analytical laboratory to be about 1/3 of the LOQ. PCB concentrations were reported for 5 samples collected over the four quarterly market baskets (Table 1). Samples with no detected PCBs (i.e., non-detects) were assumed to have concentrations of zero.

Dietary exposures were estimated by multiplying the mean PCB levels times the consumption amounts of those foods based on the 2003 TDS Diets. The 2003 TDS Diets were derived from results of USDA's 1994-98 Continuing Survey of Food Intakes by Individuals (94-98 CSFII), during which dietary data were collected for two non-consecutive days for most survey participants. The TDS Diets represent 2-day average per capita (i.e. based on dietary records for all individuals in a specific age/gender group) consumption amounts of each TDS food for 14 age/gender subgroups. The methodology for compiling the TDS Diets was described by Egan et al. (2007).

PCB mean exposures were estimated as ng/day and then converted to ng/kg body weight/day using mean body weights for 1994-98 CSFII respondents in each age/gender subgroup (Table 2). Estimated PCB exposure was highest for males ages 70 plus on the daily basis (211 ng/day); estimated PCB exposure per kg body weight was highest for females ages 60-65 years and for males 70 plus years (3 ng/kg body weight/day for each group).

Table 1. TDS PCB results for 2003

Market Basket	Food #	Food Description	Level Found (µg/kg)
1	318	Salmon, baked	38
2	318	Salmon, baked	16
3	318	Salmon, baked	22
4	318	Salmon, baked	45
2	339	Catfish, pan cooked with oil	17

Table 2. PCB Exposure Estimates based on 2003 TDS Analytical Data for PCBs

Population group	Exposures based on 2003 TDS data and TDS diets (1994-98 CSFII, mean per capita 2-day averages)	
	(µg/person/day)	(µg/kg bw/day)
6-11 mo	0.004	0.000
2 yr	0.028	0.002
6 yr	0.043	0.002
10 yr	0.039	0.001
14-16 F	0.068	0.001
14-16 M	0.044	0.001
25-30 F	0.076	0.001
25-30 M	0.080	0.001
40-45 F	0.094	0.001
40-45 M	0.098	0.001
60-65 F	0.196	0.003
60-65 M	0.198	0.002
70+F	0.151	0.002
70+M	0.211	0.003
Total US	0.100	0.002

Reference

Egan, S.K., P.M. Bolger and C.D. Carrington (2007). Update of US FDA's Total Diet Study food list and diets. *JESEE* (6):573-582.